IDB WORKING PAPER SERIES No. WP-402

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April 2013

Inter-American Development Bank
Labor Markets and Social Security Unit

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2013

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Bosch, Mariano.
The labor market effects of introducing unemployment benefits in an economy with high informality / Mariano Bosch, Julen Esteban-Pretel.
p. cm. — (IDB working paper series ; 402)
Includes bibliographic references.
1. Labor market—Mexico. 2. Unemployment insurance—Mexico. 3. Manpower policy—Mexico. 4. Labor policy—Mexico. I. Esteban-Pretel, Julen. II. Inter-American Development Bank. Labor Markets Unit. III. Title. IV. Series.
IDB-WP-402

http://www.iadb.org

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The Labor Market Effects of Introducing Unemployment Benefits in an Economy with High Informality*

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Abstract

Unemployment benefit systems are nonexistent in many developing economies. Introducing such systems poses many challenges, which are partly due to the high level of informality in the labor markets of these economies. This paper studies the consequences on the labor market of implementing an unemployment benefit system in economies with large informal sectors and high flows of workers between formality and informality. We build a search and matching model with endogenous destruction, on-the-job search, and intersectoral flows, where agents in the economy decide optimally whether or not to formalize jobs. We calibrate the model for Mexico, and show that the introduction of an unemployment benefit system, where workers contribute when employed in the formal market and collect benefits when they lose their jobs, can lead to an increase in formality in the economy, while also producing small increases in unemployment. The exact impact of incorporating such benefits depends on the relative strength of two opposing effects: the generosity of the benefits and the level of the contributions that finance those benefits. We also show important policy complementarities with other interventions in the labor market. In particular, combining the unemployment benefit program with policies that reduce the cost of formality, such as lower employment taxes and firing costs, can produce greater decreases in informality and lower impacts on unemployment than when the program is applied in isolation.

JEL classification: J64, J65, H26, O17

Keywords: Informal economy, search models, labor markets, unemployment benefits, policy interventions, Mexico.

*We are thankful for the comments and suggestions of Veronica Alaimo, James Albrecht, Jesus Fernandez-Villaverde, Hugo Hopenhayn, David Kaplan, and participants at the workshop on unemployment protection systems in high informality countries held at the Inter-American Development Bank (IDB). We respectively acknowledge the financial support for this project provided by the Japanese Ministry of Education through the Grant-in-Aid for Scientific Research, the Policy Research Center at the National Graduate Institute for Policy Studies, and the IDB Economic and Sector Work RG-1248. The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the IDB, the Japanese Ministry of Education, or the National Graduate Institute for Policy Studies.

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1 Introduction

Most workers in developing countries lack any kind of unemployment insurance. According to the International Labor Organization (ILO, 2000), 75 percent of the workers in the world have no access to income support during unemployment spells. This is due, in part, to the fact that many countries, especially low-income ones, do not have unemployment benefit (UB hereafter) systems in place. As these countries' economies grow, they begin to introduce such systems into their labor markets (see Figure 1).[1] In advanced economies, the presence of UB generates the traditional problem of moral hazard via the reduced job search efforts of discharged workers. This has been extensively studied in Pissarides (1983), Acemoglu and Shimer (1999), and Cahuc and Lehmann (2000). The implementation of UB schemes in middle-income countries, however, poses several additional challenges because of the existence of large, over-developed informal sectors.

The presence of these sectors in middle-income countries, almost by default, ensures low coverage of UB for unemployed workers. Informal workers do not pay taxes or contribute to social security, and their employment conditions are difficult to verify. Therefore, a large proportion of workers are likely not to be covered by UB. This is particularly worrisome since the data shows that informal workers seem to be more susceptible to losing their jobs. In fact, a large proportion of the flow of workers into unemployment originates from informal jobs. According to Bosch and Maloney (2008), 50 percent of unemployment volatility in Brazil and Mexico is generated by such inflows. Furthermore, panel data evidence shows that there are quantitatively important worker flows between formal and informal jobs (see Pagés and Stampini (2009) and Bosch and Maloney (2008)). This data suggests that, in countries with high informality, the UB are likely to impact not only the unemployment rate but also the employment composition between formal and informal jobs. At the same time, middle-income countries impose high costs on the dismissal of formal workers, with the double objective of protecting jobs and providing income for unemployed workers. The interaction of current employment protection measures with new UB systems can result in higher costs for the formal sector.

Given the potential impact of implementing a UB system in a labor market with large informality, the objective of this paper is to assess quantitatively the effects of introducing this sytem. In particular, we are interested in understanding the main channels through which this implementation may alter the labor market outcomes of workers and the actual quantitative impact it may have on unemployment and share of formality. To achieve this goal, we construct a search and matching model that specifically allows for key salient features of labor markets with informal jobs, and introduces essential mechanisms to understand the impact a UB system can have on an economy with substantial informality. We then calibrate and numerically solve the model for Mexico, a country with a large informal sector that has recently begun to discuss the introduction of a UB system.

There are two types of jobs, formal and informal. Firms open generic vacancies to fill both types. When matched with ex-ante identical workers, depending on the productivity of the match, a firm will establish a formal or an informal relationship. For high productivity matches, a formal relationship is

[1] Figure 1 shows, by GDP per capita quintiles, the fraction of countries that have some type of UB system in place. The results reveal that the higher the income per capita of the country, the more likely the country is to offer UB to its workers in the formal market.

often preferred. In this case, the firm has to pay employment taxes and is liable for firing costs upon dismissal of the worker. For low productivity matches, firms may find it advantageous to hire workers informally. In this case, no taxes are paid, but firms are subject to monitoring and penalties from the government.

In our model, we also allow for on-the-job search and for matches to be subject to shocks that change their idiosyncratic productivity. These factors generate endogenous job separations and flows between formal and informal jobs. We then introduce a UB system for formal workers on top of the baseline set-up just described. The UB system is such that formal workers make contributions while they are employed, and, after some time, are entitled to collect benefits if they lose their jobs. Given the inability of the government to fully monitor the informal sector, we allow for workers who are employed informally to collect UB if they had lost their previous formal jobs.

There are two main mechanisms that determine the impact of the UB system on the labor market, and, in particular, on the unemployment rate and share of formal employment. First, the UB provides an entitlement that is contingent on the worker contributing to the UB system while employed. Since only formal workers contribute, a tension arises between the size of the contribution and the generosity of the entitlement. This tension determines how incentives to obtain a formal sector job are changed vis-a-vis trying to gain informal employment. As expected, the higher the generosity of the UB with respect to the contribution rate, the stronger the incentive to get a formal sector job. Through our simulations, we find that for realistic parameterizations of the UB system, the availability of such insurance would foster transitions towards formal sector jobs, both from unemployment and informal sector jobs. The second mechanism is set in motion as workers qualify for UB, as some workers in this part of the economy can enjoy both UB and nontaxed wages, if not discovered by the government. This implies that, once workers qualify for UB collection, strong incentives exist for them to move to the informal sector.

The relative strength of these two mechanisms determines the overall change in unemployment and the share of formal employment due to the introduction of a UB system. For instance, with a replacement rate of 30 percent for six months and a contribution rate from wages of 4 percent, we find that a UB system in Mexico would decrease the share of formal employment by 6 percentage points, with no change in the unemployment rate. As we increase the generosity of the UB system, both the unemployment rate and the share of formal employment increase. With a replacement rate of 70 percent and a contribution rate of 4 percent, the unemployment rate would increase by 1.1 percentage points and the share of formal employment by 3 percentage points.

We also analyze the effects of combining the introduction of a UB system with other policy reforms, using the following three examples: lowering firing costs, lowering employment taxes, and increasing the government monitoring of the informal sector. We find that any of the three combinations would increase the share of formal employment, but at the cost of higher unemployment.

This paper is part of a growing literature on the effects of labor market policies in the presence of informal labor markets with frictions. Some examples of this literature include Kugler (1999); Bosch (2004); Fugazza and Jacques (2004); Boeri and Garibaldi (2006); Antunes and de V. Cavalcanti (2007); Zenou (2008); Albrecht, Navarro, and Vroman (2009); Bosch and Esteban-Pretel (2011); and Margolis, Navarro, and Robalino (2012). While these papers all incorporate informality and study the effects of introducing different policies, they do not assess, as the present paper does, the quantitative impact of introducing UB in a model with equilibrium unemployment and intersectoral flows as the present paper does. Our paper also resonates with an increasing interest of authors to introduce informal working arrangements into the optimal unemployment insurance design literature. For example, in their model, Álvarez-Parra and Sánchez (2009) design an optimal UB system in the presence of a shadow economy. However, this model is parameterized for the Spanish economy and does not include intersectoral flows, which, as recent empirical literature emphasizes (see Bosch and Maloney (2008)), are important in some countries, such as Brazil and Mexico. Therefore, our contribution to the literature is to build a model with key features of highly informal labor markets and provide a quantitative assessment of the impact of the introduction of a UB system on these markets, as well as a better understanding of the underlying mechanisms that effect levels of unemployment and formality. We show how the tradeoffs between contribution and replacement rates reshape the flows between the formal and informal employment sectors and unemployment and, ultimately, the composition of employment.

The rest of the paper is organized as follows. Section 2 explains the model; Section 3 details the parametrization; Section 4 displays and explains the results; and Section 5 summarizes and concludes.

2 The Model

The model is a continuous-time search and matching model of the labor market, in the style of Mortensen and Pissarides (1994), with two sectors (formal and informal), on-the-job search, endogenous job destruction, and a UB system with worker and employer contributions. The following subsection explains the model in detail.

2.1 Environment

There are three types of agents in the economy: workers, firms, and the government. Workers supply labor to firms, which produce output. The government taxes both firms and workers and supplies UB to those workers who were formally employed and who qualified to receive such benefits. Workers in search of jobs and vacant firms meet in the labor market to form employment relationships. We assume, as is standard in the literature, that such relationships are composed of one worker and one firm. Matching occurs randomly and according to a matching function $m = m(s, v)$, where s is the total number of searching workers and v is the number of vacancies. We allow on-the-job search, and hence employed workers can move directly to other jobs without transitioning through unemployment. However, we assume that the intensity of the search of workers holding a job is a fraction $\chi \in [0, 1]$ of the intensity of those who are unemployed. Hence, $s = u + \chi n$, where u and n are the total number of unemployed and employed workers, respectively. The matching technology is homogeneous of degree one, and increasing and concave in both arguments. A firm that has a vacancy match with an unemployed worker, according to a Poisson process, has an arrival rate $q(\theta) = m(s, v)/v$, where $\theta = \frac{v}{s}$ is the market tightness of the economy. Similarly, the arrival rate of vacancies for unemployed workers is $q(\theta) = m(s, v)/s$.

Since the focus of this paper is to study the effect on the labor market when introducing a UB system into an economy with a large informal sector, we need to account for the existence of a large underground economy. We assume that vacant firms are ex-ante identical and that they search for workers in a single and uncoordinated labor market. After the firm finds the worker, the two decide together whether the job will be formal or informal. Hence, informality in our model arises endogenously as the optimal economic outcome of the agents' decision.

Formal and informal jobs differ in several dimensions. On the one hand, formal jobs are subject to certain costs which are not incurred by informal jobs. These costs are: (i) a cost c to start production as a formal employment relationship; (ii) a cost F to dissolve an existing employment relationship;[2] (iii) general proportional income taxes, τ_g; and (iv) unemployment benefit contributions, which are assumed to be a fraction τ_b of the worker's salary. On the other hand, informal jobs are subject to government monitoring, which dissolves the informal match according to a Poisson process with arrival rate ϕ, and imposes a penalty of σ when discovered.

When a match is formed, either a formal or informal, output is produced. Production of the match is the sum of the aggregate productivity in the economy, p, and an idiosyncratic productivity to the match, ε. At the beginning of a match, a value of ε is drawn from a distribution $G : \left[\varepsilon^G_{\min}, \varepsilon^G_{\max}\right] \to [0, 1]$. The idiosyncratic productivity to the match changes according to a Poisson process with arrival rate λ_j for $j \in \{f, i\}$. The new levels of ε are i.i.d. and are drawn from a distribution $H_f : \left[\varepsilon^{H_f}_{\min}, \varepsilon^{H_f}_{\max}\right] \to [0, 1]$ and $H_i : \left[\varepsilon^{H_i}_{\min}, \varepsilon^{H_i}_{\max}\right] \to [0, 1]$ for formal and informal matches, respectively. This specification allows for shocks to formal and informal jobs to arrive at different rates and from distributions that potentially differ in their variance. Matches are dissolved endogenously when the idiosyncratic productivity of the match is not high enough to continue production. Additionally, as previously explained, informal matches are dissolved and penalized when discovered by the government.

The UB system is one in which formal workers contribute a fraction of their wages while employed and collect from the system when they lose their jobs. More specifically, a formal employee makes unemployment insurance contributions and, if the match is dissolved, he or she qualifies to receive unemployment benefits, b, according to a Poisson process with arrival rate ψ. Since the wages of informal workers are not disclosed to the government, such workers could potentially collect UB while being employed. Hence, we assume that both unemployed and informal workers are allowed to collect UB, had they qualified while working at a formal job. UB are terminated according to a Poisson process with arrival rate ρ.

Given the previously explained environment, the labor force of the economy is divided between employed, n, and unemployed, u, workers. The employed population is either working in the formal sector, n_f, or in the informal one, n_i. Of the formal workers, some have an on-going, productive employment relationship, and others have just started the relationship.[3] Out of the workers with on-going relationships, some have qualified to collect UB if they lose their jobs, $n_f^{o_b}$, and others have not qualified yet, $n_f^{o_z}$. Out of the new formal workers, some had been collecting unemployment insurance, $n_f^{n_b}$, and some had not, $n_f^{n_z}$. Workers in either $n_f^{n_b}$ or $n_f^{n_z}$ states have just started new formal jobs, so they have not yet qualified to collect UB if they lose their jobs after beginning production. However, if a worker who has a formal job, in which he or she has already qualified to collect UB and can also search for a new job,

[2]Note that the costs c and F only apply to employment relationships. These differ from pure matches in that a match that has just been formed may not become an employment relationship if the worker and the firm decide that their options are more valuable outside than they are inside the employment relationship.

[3]In this case, firing costs do not apply since such costs are only paid when dissolving an on-going employment relationship, and not when breaking a match that has just formed and is not yet productive.

moves to a new formal job, he or she is still qualified for UB collection. This creates a new state for new formal workers, which we denote by $n_f^{n_q}$. An unemployed worker may still be collecting UB from the government, u^b, or he or she may have run out of it, u^z. Similarly, informal workers may be collecting such benefits, n_i^b, or may have ceased to do so, n_i^z. Based on this model, there are nine different states that workers may find themselves in (see Figure 2). The following subsections develop the problem of the firm and the worker, and explain the decisions they may face.

2.2 Problem of the Firm

Firms posts vacancies in the labor market and try to match them with available workers, with the goal of creating a productive employment relationship. Firms are ex-ante identical, but differ once they form a match with a worker.

Value of a Vacancy for the Firm

The value of an unfilled job for a firm, V, is discounted at rate r, and is composed by the flow cost of having the vacancy posted, k, and the expected return from the potential match with a worker. The expected future value of a vacancy can be understood as follows. According to a Poisson process with arrival rate $q(\theta)$, the firm meets a potential worker from a pool of workers, a fraction $\gamma_u = \frac{u^b}{u+\chi n}$ of which were unemployed collecting UB. If a firm matches with this worker, it draws an initial value of the idiosyncratic productivity ε and decides to hire the worker as a formal employee, which has a set-up cost of c and provides a value of $J_f^{n_b}(\varepsilon)$; to hire him or her as an informal worker, which has a value of $J_i^b(\varepsilon)$ and no set-up cost; or not to form an employment relationship at all and remain as a vacant firm, which has a value of V. With probability $\gamma_n = \frac{\chi\left(n_f^{n_q}+n_f^{o_b}\right)}{u+\chi n}$, the firm is matched with a worker who was previously employed in a formal job and had already qualified for UB collection. The firm then makes a similar decision between hiring the worker under a formal agreement, which has a value of $J_f^{n_q}(\varepsilon)$ and a set-up cost of c; hiring him or her informally, with value $J_i^b(\varepsilon)$; or remaining vacant. Finally, a fraction $(1-\gamma_u-\gamma_n)$ of the searching population is not collecting UB or, if employed, has not qualified for such benefits. The problem for the vacant firm is then similar, but the values of formal and informal hiring are $J_f^{n_z}(\varepsilon)-c$ and $J_i^z(\varepsilon)$, respectively. If matched with a worker, the firm loses the value of being vacant. The following expression shows the value for a firm to post a vacancy in the labor market:

$$\begin{aligned} rV \quad = \quad & -k+q(\theta)\left\{\gamma_u\int_{\varepsilon_{\min}^G}^{\varepsilon_{\max}^G}\max\left[J_f^{n_b}(\varepsilon')-c, J_i^b(\varepsilon'), V\right]dG(\varepsilon')\right. \\ & +\gamma_n\int_{\varepsilon_{\min}^G}^{\varepsilon_{\max}^G}\max\left[J_f^{n_q}(\varepsilon')-c, J_i^b(\varepsilon'), V\right]dG(\varepsilon') \\ & \left.+(1-\gamma_u-\gamma_n)\int_{\varepsilon_{\min}^G}^{\varepsilon_{\max}^G}\max\left[J_f^{n_z}(\varepsilon')-c, J_i^z(\varepsilon'), V\right]dG(\varepsilon')-V\right\} \end{aligned} \tag{1}$$

We assume that there is free entry of firms into the labor market, which implies that in equilibrium, $V=0$ since $q(\theta)$ is decreasing in the number of vacancies.

Values of a Filled Job for the Firm

Since workers can be in one of seven states while employed (see Figure 2), there are also seven different values for a firm to fill a job, as expressed in the following.

Firm hiring a worker for a formal job who has not qualified for UB collection. In this case, the present discounted value in a match with idiosyncratic productivity ε is $rJ_f^s(\varepsilon)$, where $s = n_b$ if the worker had been employed in a formal job and was collecting UB; $s = n_z$ if the worker was not employed formally and he or she was not collecting UB; and $s = o_z$ if the worker had been employed in a formal job, but had not yet qualified for UB collection. This value is expressed as follows:

$$
\begin{aligned}
rJ_f^s(\varepsilon) \quad = \quad & p + \varepsilon - \left(1 + \tau_g^f + \tau_b^f\right) w_f^s(\varepsilon) + \lambda_f \left[\int_{\varepsilon_{\min}^{H_f}}^{\varepsilon_{\max}^{H_f}} \max\left[J_f^{o_z}(\varepsilon'), J_i^z(\varepsilon') - F, V - F\right] dH_f(\varepsilon') - J_f^s(\varepsilon) \right] \\
& + \varphi \left[\int_{\varepsilon_{\min}^{H_f}}^{\varepsilon_{\max}^{H_f}} \max\left[J_f^{o_b}(\varepsilon'), J_i^b(\varepsilon') - F, V - F\right] dH_f(\varepsilon') - J_f^s(\varepsilon) \right] \\
& + \eta\left(V - J_f^s(\varepsilon)\right) \text{ for } s \in \{n_b, n_z, o_z\}
\end{aligned} \tag{2}
$$

This value is interpreted as follows. The firm produces output $p + \varepsilon$, and pays wages $w_f^s(\varepsilon)$, which are taxed at rate τ_g^f and also increased by the amount contributed to the UB system, which is a fraction τ_b^f of the wage. With arrival rate λ_f, the idiosyncratic productivity changes and the match draws a new value from the distribution H_f. The firm loses the value of the current match, $J_f^s(\varepsilon)$ and, depending on the new value ε', the firm decides whether to keep hiring the worker in an on-going formal match, which has value $J_f^{o_z}(\varepsilon')$; to hire the worker as an informal employee, which has a value $J_i^z(\varepsilon')$; or to dissolve the match completely and search for a new worker. The last two options require breaking a formal match, which involves a cost F. With arrival rate φ, the worker being hired qualifies to collect UB. For the firm, this change in status also implies the loss of the current value, as well as the draw of a new idiosyncratic productivity and similar choices as before, but in this case the values of hiring the worker formally and informally are $J_f^{o_b}(\varepsilon')$ and $J_i^b(\varepsilon')$, respectively. Finally, if the worker finds a new opportunity while still on the job, with arrival rate η, he or she may leave and, thus, the firm would become vacant.

Firm hiring a worker for a formal job who has qualified for UB collection. In this case, the present value of the filled job for the firm is $rJ_f^h(\varepsilon)$, where $h = n_q$ if the worker is starting a new formal job and $h = o_b$ if the match is on-going. The interpretation of this value is similar to that of a firm hiring a worker for a formal job who has not yet qualified for collection of UB. The only difference is that, since the worker in this firm has already qualified for UB, he or she does not get hit by the qualification shock (which occurs at rate φ for nonqualified workers). The expression for $J_f^s(\varepsilon)$ is as follows:

$$
\begin{aligned}
rJ_f^h(\varepsilon) \quad = \quad & p + \varepsilon - \left(1 + \tau_g^f + \tau_b^f\right) w_f^{n_q}(\varepsilon) + \lambda_f \left[\int_{\varepsilon_{\min}^{H_f}}^{\varepsilon_{\max}^{H_f}} \max\left[J_f^{o_b}(\varepsilon'), J_i^b(\varepsilon') - F, V - F\right] dH_f(\varepsilon') - J_f^{o_b}(\varepsilon) \right] \\
& + \eta\left(V - J_f^{o_b}(\varepsilon)\right) \text{ for } h \in \{n_q, o_b\}
\end{aligned} \tag{3}
$$

Firm hiring a worker for an informal job. In this case, the present value of a filled job is $rJ_i^j(\varepsilon)$, where $j = b$ if the worker is collecting UB and $j = z$ if he or she is not collecting UB. The value for a firm to hire a worker for an informal job has a similar form to the value of hiring the worker for a formal one, but it differs in the following ways: (i) the firm does not pay employment taxes, hence the expenditure in wages is simply $w_i^j(\varepsilon)$; (ii) the arrival rate of a new idiosyncratic productivity is λ_i and the new value is drawn from a distribution H_i; (iii) if the worker is collecting UB, he or she stops collecting according to a Poisson process with arrival rate ρ, and then the match draws a new value of ε and decides how to proceed; and (iv) the firm may get discovered by the government according to a Poisson process with arrival rate ϕ, in which case it gets fined σ and the match is dissolved. The expression for the value for a firm which hires a worker for an informal job is:

$$\begin{aligned} rJ_i^j(\varepsilon) \quad = \quad & p + \varepsilon - w_i^j(\varepsilon) + \lambda_i \left[\int_{\varepsilon_{\min}^{H_i}}^{\varepsilon_{\max}^{H_i}} \max \left[J_f^{n_j}(\varepsilon') - c, J_i^j(\varepsilon'), V \right] dH_i(\varepsilon') - J_i^j(\varepsilon) \right] \\ & + \mathbb{I}_{j=b}\rho \left[\int_{\varepsilon_{\min}^{H_i}}^{\varepsilon_{\max}^{H_i}} \max \left[J_f^{n_z}(\varepsilon') - c, J_i^z(\varepsilon'), V \right] dH_i(\varepsilon') - J_i^j(\varepsilon) \right] \\ & + \eta \left(V - J_i^j(\varepsilon) \right) + \phi \left(V - J_i^j(\varepsilon) \right) - \phi\sigma \text{ for } j \in \{b, z\} \end{aligned} \tag{4}$$

where $\mathbb{I}_{j=b}$ is an indicator function that equals 1 if the worker at the firm is collecting UB.

2.3 Problem of the Worker

As previously mentioned, there are nine possible states for a worker in the labor force (see Figure 2). These different states depend on whether the worker is employed or unemployed; has a formal job or an informal one; is collecting UB or not; and, if employed in a formal job, has qualified for UB collection. The following explains the values for the worker of being in all states and the decisions he or she may face.

Value of Unemployment

The present value of being unemployed for a worker is denoted by rU^j, where $j = b$ if the worker is collecting UB, and $j = z$ if he or she is not. This value can be expressed in the following way:

$$\begin{aligned} rU^j \quad = \quad & z + \mathbb{I}_{j=b} b + \theta q(\theta) \left[\int_{\varepsilon_{\min}^{G}}^{\varepsilon_{\max}^{G}} \max \left[W_f^{n_j}(\varepsilon'), W_i^j(\varepsilon'), U^j \right] dG(\varepsilon') - U^j \right] \\ & + \mathbb{I}_{j=b}\rho \left(U^z - U^b \right) \text{ for } j \in \{b, z\} \end{aligned} \tag{5}$$

The interpretation of the previous equation is simple. An unemployed worker gets flow value of leisure, z, and the unemployment benefits, b, if he or she is still collecting them. Then, if matched with a firm, which occurs according to a Poisson process with arrival rate $\theta q(\theta)$, the worker loses the value of unemployment and, after drawing a value of the idiosyncratic productivity ε, the worker decides how to continue. He or she can start employment in a formal job, which gives value $W_f^{n_j}(\varepsilon)$; be employed in an informal job, which gives value $W_i^j(\varepsilon)$; or remain unemployed. An unemployed worker collecting UB also faces the possibility of the termination of such benefits. This occurs according to a Poisson process with arrival rate ρ, and where in the previous expression $\mathbb{I}_{j=b}$ denotes an indicator function that equals 1 if the unemployed worker is collecting UB.

Value of Employment

Formal employment for a worker who has not qualified for UB collection. In this case, the present value of employment for the worker is $rW_f^s(\varepsilon)$, where, as in the case of the value of the firm, $s = n_b$ if the worker has just found a formal job and was previously collecting UB; $s = n_z$ if the worker is in a new match and was not collecting UB in the previous state; and $s = o_z$ if he or she was working in a formal job and had not yet qualified for UB. The expression for $rW_f^s(\varepsilon)$ is:

$$\begin{aligned} rW_f^s(\varepsilon) \; = \; & \left(1-\tau_g^w-\tau_b^w\right) w_f^s(\varepsilon)+\lambda_f\left[\int_{\varepsilon_{\min}^{H_f}}^{\varepsilon_{\max}^{H_f}} \max\left[(W_f^{o_z}(\varepsilon'), W_i^z(\varepsilon'), U^z\right] dH_f(\varepsilon') - W_f^s(\varepsilon)\right] \\ & +\chi\theta q(\theta)\left[\int_{\varepsilon_{\min}^{G}}^{\varepsilon_{\max}^{G}} \max\left[W_f^{n_z}(\varepsilon'), W_i^z(\varepsilon'), U^z\right] dG(\varepsilon') - W_f^s(\varepsilon)\right] \\ & +\varphi\left[\int_{\varepsilon_{\min}^{H_f}}^{\varepsilon_{\max}^{H_f}} \max\left[(W_f^{o_b}(\varepsilon'), W_i^b(\varepsilon'), U^b\right] dH_f(\varepsilon') - W_f^s(\varepsilon)\right] \text{ for } s\in\{n_b,n_z,o_z\} \end{aligned} \qquad (6)$$

The previous equation is interpreted as follows. A formal worker who has not yet qualified for UB collects a wage $w_f^s(\varepsilon)$, pays the government a fraction τ_g^w in general taxes, and contributes a fraction τ_b^w to unemployment insurance. With arrival rate λ_f, the match draws a new value of the idiosyncratic productivity, in which case the worker loses the current value, $W_f^s(\varepsilon)$, and decides whether to continue working for the same firm as a formal worker, which gives value $W_f^{o_z}(\varepsilon')$; find an informal job, which gives value $W_i^z(\varepsilon')$; or go into unemployment. While employed, the worker searches for new job opportunities, although at a lower intensity than when unemployed. According to a Poisson process with arrival rate $\chi\theta q(\theta)$, he or she matches with a new firm. We assume that, if matched with a new firm, the worker will leave the current job and decide on the employment conditions with the new firm, without the possibility of going back to the previous job.[4] Since the worker had not yet qualified for UB, the options for the worker and the respective values are to work formally $W_f^{n_z}(\varepsilon')$, work informally $W_i^z(\varepsilon')$, or become unemployed U^z. Finally, with arrival rate φ, the worker qualifies to collect UB and, after drawing a new value of ε, he or she decides how to proceed, which involves continuing to work formally with value $W_f^{o_b}(\varepsilon')$, to find an informal job $W_i^b(\varepsilon')$, or to move into unemployment.

Formal employment for a worker who qualifies for UB collection. In this case, the value of employment for the worker is similar to that of a worker who has not yet qualified for UB, and only differs in that it does not have the term corresponding to the UB qualification. The expression is as follows:

[4] This assumption greatly simplifies the bargaining problem between the worker and the firm.

$$rW_f^h(\varepsilon) = \left(1-\tau_g^w-\tau_b^w\right) w_f^h(\varepsilon) + \lambda_f \left[\int_{\varepsilon_{\min}^{H_f}}^{\varepsilon_{\max}^{H_f}} \max \left[(W_f^{o_b}(\varepsilon'), W_i^b(\varepsilon'), U^b \right] dH_f(\varepsilon') - W_f^h(\varepsilon) \right]$$
$$+\chi\theta q(\theta) \left[\int_{\varepsilon_{\min}^{G}}^{\varepsilon_{\max}^{G}} \max \left[W_f^{n_q}(\varepsilon'), W_i^b(\varepsilon'), U^b \right] dG(\varepsilon') - W_f^h(\varepsilon) \right] \text{ for } h \in \{n_q, o_b\} \quad (7)$$

Informal employment. In this case, the value of employment for the worker is $rW_i^j(\varepsilon)$, where $j = b$ if the worker still collects UB, and $j = z$ if he or she does not. The expression is similar to that of being employed in a formal job, except that workers in informal jobs do not pay taxes; the arrival rate for a new value of ε is λ_i; there is the possibility of stopping the UB collection (with arrival rate ρ); and, if caught by the government, the worker can be forced into unemployment without the possibility of collecting UB (with arrival rate ϕ).

$$rW_i^j(\varepsilon) = w_i^j(\varepsilon) + \mathbb{I}_{j=b} b + \lambda_i \left[\int_{\varepsilon_{\min}^{H_i}}^{\varepsilon_{\max}^{H_i}} \max \left[(W_f^{n_j}(\varepsilon'), W_i^j(\varepsilon'), U^j \right] dH_i(\varepsilon') - W_i^j(\varepsilon) \right]$$
$$+\chi \left[\theta q(\theta) \int_{\varepsilon_{\min}^{G}}^{\varepsilon_{\max}^{G}} \max \left[W_f^{n_j}(\varepsilon'), W_i^j(\varepsilon'), U^j \right] dG(\varepsilon') - W_i^j(\varepsilon) \right] \quad (8)$$
$$+\mathbb{I}_{j=b}\rho \left[\int_{\varepsilon_{\min}^{H_i}}^{\varepsilon_{\max}^{H_i}} \max \left[(W_f^{n_z}(\varepsilon'), W_i^z(\varepsilon'), U^z \right] dH_i(\varepsilon') - W_i^b(\varepsilon) \right]$$
$$+\phi \left(U^z - W_i^j(\varepsilon) \right) \text{ for } j \in \{b, z\}$$

2.4 Surplus

When a firm and a worker form an employment relationship, a surplus is created. This surplus is the sum of what the firm and the worker gain by being in a productive match, net of what they lose. Since there are seven possible employment states for the worker, there are as many surpluses. We can define them as follows for new formal matches

$$S_f^{n_j}(\varepsilon) = \left(J_f^{n_j}(\varepsilon) - c \right) + W_f^{n_j}(\varepsilon) - V - (1-\mathbb{I}_{j=b}) U^j - \mathbb{I}_{j=b} U^b \text{ for } j \in \{b, z, q\}, \quad (9)$$

for on-going matches

$$S_f^{o_j}(\varepsilon) = J_f^{o_j}(\varepsilon) + W_f^{o_j}(\varepsilon) - (V - F) - U^j \text{ for } j \in \{b, z\}, \quad (10)$$

and for informal matches

$$S_i^j(\varepsilon) = J_i^j(\varepsilon) + W_i^j(\varepsilon) - V - U^j \text{ for } j \in \{b, z\}. \quad (11)$$

Using equations (1) to (8), it is possible to find the expressions for each of the surpluses, as shown in Appendix B.

2.5 Wages

Wages are chosen as the Nash solution to the bargaining problem between the worker and the firm, where β_f and β_i are the bargaining powers of the formal and informal workers, respectively. Therefore, in new formal matches, wages solve the problem

$$w_f^{n_j}(\varepsilon) = \arg\max \left(J_f^{n_j}(\varepsilon) - c - V\right)^{1-\beta_f} \left(W_f^{n_j}(\varepsilon) - (1 - \mathbb{I}_{j=b}) U^j - \mathbb{I}_{j=b} U^b\right)^{\beta_f} \text{ for } j \in \{b, z, q\},$$

in on-going formal matches

$$w_f^{o_j}(\varepsilon) = \arg\max \left(J_f^{o_j}(\varepsilon) - (V - F)\right)^{1-\beta_f} \left(W_f^{o_j}(\varepsilon) - U^j\right)^{\beta_f} \text{ for } j \in \{b, z\},$$

and in informal matches

$$w_i^{n_j}(\varepsilon) = \arg\max \left(J_i^{n_j}(\varepsilon) - V\right)^{1-\beta_f} \left(W_i^{n_j}(\varepsilon) - U^j\right)^{\beta_f} \text{ for } j \in \{b, z\}.$$

The previous problems deliver the optimal sharing rule for the surplus of the match. Given that this model includes taxes for the formal sector, the division of the surplus between the firm and the worker differs from the standard condition for these types of firms. For new formal matches, the sharing rule is

$$W_f^{n_j}(\varepsilon) - (1 - \mathbb{I}_{j=b}) U^j - \mathbb{I}_{j=b} U^b = \hat{\beta}_f S_f^{n_j}(\varepsilon) \text{ and } J_f^{n_j}(\varepsilon) - c = \left(1 - \hat{\beta}_f\right) S_f^{n_j}(\varepsilon) \text{ for } j \in \{b, z, q\}, \tag{12}$$

where $\hat{\beta}_f \equiv \frac{\beta_f\left(1-\tau_g^w-\tau_b^w\right)}{(1-\beta_f)\left(1+\tau_g^f+\tau_b^f\right)+\beta_f\left(1-\tau_g^w-\tau_b^w\right)}$.

For on-going formal matches, the sharing rule is

$$W_f^{o_j}(\varepsilon) - U^j = \hat{\beta}_f S_f^{o_j}(\varepsilon) \text{ and } J_f^{o_j}(\varepsilon) + F = \left(1 - \hat{\beta}_f\right) S_f^{o_j}(\varepsilon) \text{ for } j \in \{b, z\}. \tag{13}$$

The sharing rule for an informal firm is equivalent to the standard textbook sharing rule since the firm does not have to pay employment taxes or firing costs:

$$W_i^j(\varepsilon) - U^j = \beta_i S_i^j(\varepsilon) \text{ and } J_i^j(\varepsilon) = (1 - \beta_i) S_i^j(\varepsilon) \text{ for } j \in \{b, z\} \tag{14}$$

2.6 Thresholds

The value functions in equation (1) to (8) pose problems for firms and workers, such as when to convert a new match into a productive relationship; whether the job should be formal or informal, if the match is converted; and when to dissolve a match and search for better options. The solution to such problems is of the form of idiosyncratic productivity thresholds that separate the different options.

In the model, there are nine thresholds that determine the formal versus informal job choice and the match dissolution decision.[5] These thresholds, ε_R^j for $j \in \{b, z, q\}$ and ε_T^j for $j \in \{b, z\}$, are the values of

[5]Note that we will parametrize the model such that a new match always becomes an employment relationship. That is, there is no productivity value in the distribution G for which the match does not become productive. In equilibrium, for

the idiosyncratic productivity that determine the formal versus informal job choice for new and on-going matches, respectively, where the job will be formal only if the value of ε is above that threshold. The value of the productivity that determines the dissolution of the formal and informal matches is $\varepsilon^j_{D_f}$ and $\varepsilon^j_{D_i}$ for $j \in \{b, z\}$ respectively, where matches are dissolved whenever ε falls below that level.

The threshold levels are determined as the levels of the idiosyncratic productivity that make the value for the firm, as well as for the worker,[6] the same whether the worker is hired formally or informally for ε^j_R and ε^j_T , and give a value of zero for the separation thresholds $\varepsilon^j_{D_f}$ and $\varepsilon^j_{D_i}$. The actual values of the thresholds can be found in Appendix B.

The conditions that determine the thresholds are the following:

- For the formal versus informal job choice for new matches, ε^j_R for $j \in \{b, z, q\}$:

$$J^{n_j}_f\left(\varepsilon^j_R\right) - c = J^j_i\left(\varepsilon^j_R\right). \tag{15}$$

- For the formal versus informal job decision for on-going matches, ε^j_T for $j \in \{b, z\}$:

$$J^{o_j}_f\left(\varepsilon^j_T\right) + F = J^j_i\left(\varepsilon^j_T\right). \tag{16}$$

- For the match dissolution decision of informal jobs, $\varepsilon^j_{D_i}$ for $j \in \{b, z\}$:

$$J^j_i\left(\varepsilon^j_{D_i}\right) = 0. \tag{17}$$

- For the match dissolution of formal jobs, $\varepsilon^j_{D_f}$ for $j \in \{b, z\}$:

$$\varepsilon^j_{D_f} = max\left\{\varepsilon^{o_j}_f, \varepsilon^j_{D_i}\right\}, \tag{18}$$

  where

$$J^{o_j}_f\left(\varepsilon^{o_j}_f\right) + F = 0. \tag{19}$$

The reason for the separation threshold for formal jobs to be the maximum of $\varepsilon^{o_j}_f$ and $\varepsilon^j_{D_i}$ is that formal jobs can become informal if the productivity is low. Hence, when ε falls below ε^j_T it is not worth it for the firm to maintain the formal job and, thus, the value of informality becomes relevant. However, it is possible that the optimal thresholds are such that $\varepsilon^j_T < \varepsilon^j_{D_i}$, and in this case, since the productivity value that makes the formal surplus zero is higher than that for the informal surplus, $\varepsilon^{o_j}_f > \varepsilon^j_{D_i}$, the firm and worker are better off dissolving the formal match than downgrading it to become informal. Therefore,

new matches, the firm-worker pair will always find it optimal to start production and only have to decide whether the job is to be formal or informal. This assumtpion is made due to the lack of data on the fraction of firm-worker matches that do not result in an employment offer, which makes it difficult to have a target that the model can try to reproduce.

[6]It is easy to see from the surplus sharing conditions (9) to (14) that, for instance, whichever ε implies a value of zero for one of the firm's present value functions also makes the surplus of the match, and therefore the value for the worker, equal to zero. Hence, when it is in the interest of a firm to either dissolve a match or turn it formal or informal, it is also optimal for the worker.

our model delivers the possibility of multiple equilibria.[7] In particular, there is the possibility of an equilibrium where there is downgrading of formal jobs into informal ones, in which case $\varepsilon^j_{D_f} = \varepsilon^j_{D_i}$, and one where there is no downgrading, in which $\varepsilon^j_{D_f} = \varepsilon^{o_j}_f$. Note that even if the equilibrium of the model is one in which there is no downgrading, there may still be direct flows from formal to informal states; for example, a worker may move from a formal job to an informal job as a result of on-the-job searching. Also, in this case, there may still be upgrading of informal jobs to become formal since the formal versus informal job decision that a filled firm faces when hiring a worker for an informal job would be the same one as the decision for a vacant firm hiring a new worker. That is, the relevant threshold for upgrading of informal jobs is ε^j_R since, as can be seen from equations (1) and (4), the problem posed to a firm hiring a worker for an on-going job when the value of ε changes is the same as the problem that a firm faces when it first meets a worker.

2.7 Flow Equations

Given the way firms and workers make decisions, the following flow equations can be used to explain how the different states for workers evolve in the model.

Total unemployment is

$$u = u^b + u^z,$$

where the evolution of u^b and u^z is

$$\begin{aligned} u^b &= [1 - \theta q(\theta) - \rho] u^b + \lambda_i H_i \left(\varepsilon^b_{D_i}\right) n^b_i + \lambda_f H_f \left(\varepsilon^b_{D_f}\right) \left(n^{n_q}_f + n^{o_b}_f\right) \\ &\quad + \varphi H_f \left(\varepsilon^z_{D_f}\right) \left(n^{n_b}_f + n^{n_z}_f + n^{o_z}_f\right), \end{aligned} \tag{20}$$

$$\begin{aligned} u^z &= [1 - \theta q(\theta)] u^z + \rho \left[u^b + H_i \left(\varepsilon^z_{D_i}\right) n^b_i\right] + \left(\lambda_i H_i \left(\varepsilon^z_{D_i}\right) + \phi\right) n^z_i \\ &\quad + \phi n^b_i + \lambda_f H_f \left(\varepsilon^z_{D_f}\right) \left(n^{n_b}_f + n^{n_z}_f + n^{o_z}_f\right). \end{aligned} \tag{21}$$

Formal employment is

$$n_f = n^{n_b}_f + n^{n_z}_f + n^{n_q}_f + n^{o_z}_f + n^{o_b}_f,$$

where the evolution of the five formal employment states is

[7] For the calibration of the model that delivers the results show in Section 4, the model economy has downgrading of formal jobs into informal ones.

$$n_f^{n_b} = \left[1-\lambda_f-\varphi-\chi\theta q(\theta)\right] n_f^{n_b} + \theta q(\theta)\left[1-G\left(\varepsilon_R^b\right)\right]\left[u^b+\chi n_i^b\right] + \lambda_i\left[1-H_i\left(\varepsilon_R^b\right)\right] n_i^b, \quad (22)$$

$$n_f^{n_z} = \left[1-\lambda_f-\varphi-\chi\theta q(\theta) G\left(\varepsilon_R^z\right)\right] n_f^{n_z} + \theta q(\theta)\left[1-G\left(\varepsilon_R^z\right)\right]\left[u^z+\chi\left(n_f^{n_b}+n_i^z+n_f^{o_z}\right)\right] \quad (23)$$
$$+\left[1-H_i\left(\varepsilon_R^z\right)\right]\left(\lambda_i n_i^z+\rho n_i^b\right),$$

$$n_f^{n_q} = \left[1-\lambda_f-\chi\theta q(\theta) G\left(\varepsilon_R^q\right)\right] n_f^{n_q} + \chi\theta q(\theta)\left[1-G\left(\varepsilon_R^q\right)\right] n_f^{o_b}, \quad (24)$$

$$n_f^{o_b} = \left[1-\lambda_f H_f\left(\varepsilon_T^b\right)-\chi\theta q(\theta)\right] n_f^{o_b} + \left[1-H_f\left(\varepsilon_T^b\right)\right]\left[\lambda_f n_f^{n_q}+\varphi\left(n_f^{n_b}+n_f^{n_z}+n_f^{o_z}\right)\right], \quad (25)$$

$$n_f^{o_z} = \left[1-\lambda_f H_f\left(\varepsilon_T^z\right)-\varphi-\chi\theta q(\theta)\right] n_f^{o_z} + \lambda_f\left[1-H_f\left(\varepsilon_T^z\right)\right]\left(n_f^{n_z}+n_f^{n_b}\right). \quad (26)$$

Informal employment is

$$n_i = n_i^b + n_i^z,$$

where n_i^b and n_i^z evolve according to the following equations

$$n_i^b = \left[1-\lambda_i\left(1-\left[H_i\left(\varepsilon_R^b\right)-H_i\left(\varepsilon_{D_i}^b\right)\right]\right)-\chi\theta q(\theta)\left[1-G\left(\varepsilon_R^b\right)\right]-\phi-\rho\right] n_i^b \quad (27)$$
$$+\theta q(\theta)\left(G\left(\varepsilon_R^b\right) u^b+\chi G\left(\varepsilon_R^q\right)\left(n_f^{n_q}+n_f^{o_b}\right)\right)$$
$$+\left[H_f\left(\varepsilon_T^b\right)-H_f\left(\varepsilon_{D_f}^b\right)\right]\left[\lambda_f\left(n_f^{n_q}+n_f^{o_b}\right)+\varphi\left(n_f^{n_b}+n_f^{n_z}+n_f^{o_z}\right)\right],$$

$$n_i^z = \left[1-\lambda_i\left(1-\left[H_i\left(\varepsilon_R^z\right)-H_i\left(\varepsilon_{D_i}^z\right)\right]\right)-\chi\theta q(\theta)\left[1-G\left(\varepsilon_R^z\right)\right]-\phi\right] n_i^z + \quad (28)$$
$$\rho\left[H_i\left(\varepsilon_R^z\right)-H_i\left(\varepsilon_{D_i}^z\right)\right] n_i^b + \theta q(\theta) G\left(\varepsilon_R^z\right)\left[u^z+\chi\left(n_f^{n_b}+n_f^{n_z}+n_f^{o_z}\right)\right]$$
$$+\lambda_f\left[H_f\left(\varepsilon_T^z\right)-H_f\left(\varepsilon_{D_f}^z\right)\right]\left(n_f^{n_b}+n_f^{n_z}+n_f^{o_z}\right).$$

We normalize the labor force to unity such that

$$1 = u^b+u^z+n_f^{n_b}+n_f^{n_z}+n_f^{n_q}+n_f^{o_z}+n_f^{o_b}+n_i^b+n_i^z. \quad (29)$$

2.8 Equilibrium

A stationary equilibrium in this economy is: (I) a set of thresholds, $\left\{\varepsilon_R^b, \varepsilon_R^z, \varepsilon_R^q, \varepsilon_T^b, \varepsilon_T^z, \varepsilon_{D_f}^b, \varepsilon_{D_f}^z, \varepsilon_{D_i}^b, \varepsilon_{D_i}^z\right\}$; (II) the market tightness, θ; and (III) a set of employment and unemployment rates, $\left\{u^b, u^z, n_f^{n_b}, n_f^{n_z}, n_f^{n_q}, n_f^{o_z}, n_f^{o_b}, n_i^b, n_i^z\right\}$, that satisfy: (i) the optimal decision of firms and workers as stated in the threshold conditions (15) to (19); (ii) the vacancy posting condition, equation (1) after imposing that in equilibrium $V=0$; and (iii) the flow equations (20) to (29).

3 Parametrization

The model presented in Section 2 does not have an analytical solution, and therefore we solve it numerically. In order to find the numerical solution to the equilibrium of the economy, it is necessary to assign values to the model parameters. A subset of the parameters is set exogenously, either through normalizations or by using values which have become standard in the literature. For the other subset of parameters, we use data from Mexico from 1987Q1 to 2010Q4 to calculate long-run averages of key variables in the labor market. We then find parameter values that deliver a steady-state equilibrium of the model that is consistent with such empirical evidence (see Table 1). The version of the model used for the calibration of the endogenous parameters is one without UB, which is currently the case in Mexico.[8] This section explains how the model parameters are chosen.

The time period in the model is one month, or 30 days. We set the interest rate to $r = 0.005$, which delivers a yearly interest rate of 6 percent; this corresponds to the average for the Mexican benchmark rate in recent years. The matching function is assumed to be Cobb-Douglas, $m = \mu u^{\xi} v^{1-\xi}$, with unemployment elasticity $\xi = 0.5$, which is consistent with the estimates from Petrongolo and Pissarides (2001). The scaling parameter, μ, is jointly calibrated with other parameters of the model, as discussed later herein. We assume that the bargaining power for the worker is higher for the formal sector than it is for the informal sector, with values of $\beta_f = 0.54$ and $\beta_i = 0.46$, respectively. This implies an average worker bargaining power of 0.5, as is standard in the literature.

The risks of operating in the informal sector in the model are captured by the monitoring rate, ϕ, and the penalty for detection, σ. There is very little evidence on the level of government monitoring of the informal economy, especially for Mexico. Almeida and Carneiro (2009) use the World Bank's Investment Climate Survey of a set of Brazilian manufacturing firms to study the impact of the enforcement of regulations on firm performance. They find that around 0.5 percent of surveyed firms receive some kind of fine related to labor regulations within a given quarter. Since there is no similar estimate for Mexican firms, we use this value for our calibration, and set the separation of informal jobs due to monitoring to $\phi = 0.0017$ in a month. However, changing the level of ϕ does not affect the baseline simulation results, as it rescales the value of σ, which is endogenously calibrated so that the model matches the imposed targets in the calibration.

The corporate and payroll taxes in Mexico total 32 percent. We use this number as the value for the general government taxes and set $\tau_g = 0.32$. The World Bank's Doing Business database provides estimates of the costs of formality in Mexico. Based on the data, firms in Mexico have to spend, on average, between two to five days to register a firm with the social security institute (Instituto Mexicano del Seguro Social, or IMSS), which includes the registration and formalization of workers. We take part of this as a proxy for the output forgone by a formal match due to hiring costs and, since the time period is one month, we set $c = 4/30$.

Calibration of the flow value of leisure, z, has attracted significant attention in the U.S. literature.[9]

[8] We can reduce the model to one where there is no UB system by assuming that $b = 0$, $\tau_b = 0$,$\varphi = 0$, $\rho = 0$. If we make the previous two assumptions, the states for b and z, above, are no longer different, so there is no distinction between u^b and u^z (they can simply be counted as u); between n_i^b and n_i^z (they can simply be counted as n_i); between $n_f^{n_b}$ and $n_f^{n_z}$ and $n_f^{n_q}$ (they can simply be counted as n_f^n); and between $n_f^{o_z}$ and $n_f^{o_b}$(they can simply be counted as n_f^o).

[9] While our model focuses on the steady state of the economy, and the recent discussion about this value is more relevant

In general terms, the flow value of unemployment captures elements such as the value of leisure, UB, and home production. Shimer (2005) chooses to set this parameter at 40 percent of productivity, whereas Hagedorn and Manovskii (2008) elect a much higher value, close to 95 percent of productivity. Given that in our model, unemployment benefits, b, are separate for the value of leisure, z, we choose z to be at the lower end of this spectrum, so that when we introduce UB, the sum of both terms $(b+z)$ lies in the middle of the range of discussed values. We set $z = 0.5$, which in our model corresponds to 50 percent of average productivity.[10] The distributions $G, H_f,$and H_i are assumed to be uniform in the intervals $\left[\varepsilon^G_{\min}, \varepsilon^G_{\max}\right]$, $\left[\varepsilon^{H_f}_{\min}, \varepsilon^{H_f}_{\max}\right]$, and $\left[\varepsilon^{H_i}_{\min}, \varepsilon^{H_i}_{\max}\right]$, respectively. We normalize the maximum of the distributions to 1, that is $\varepsilon^G_{\max} = \varepsilon^{H_f}_{\max} = \varepsilon^{H_i}_{\max} = 1$, and calibrate the minimums as explained below.

The remaining parameters are jointly calibrated so that the steady state version of the model, without UB, matches certain facts of the long-run empirical evidence for Mexico. In particular, the values of $\varepsilon^G_{\min}$, $\varepsilon^{H_f}_{\min}$, and $\varepsilon^{H_i}_{\min}$ are calibrated jointly with the values of the endogenous variables θ, ε_R, ε_{D_f}, ε_{D_i}, and ε_T,[11] and the seven remaining exogenous parameters in the model, which are the cost of posting a vacancy, k; the firing cost, F; the scaling parameter in the matching function, μ; the penalty for informal firms that get caught, σ; the on-the-job search efficiency parameter, χ; and the arrival rates of idiosyncratic productivity shocks λ_f and λ_i. The 15 values for these parameters and endogenous variables are calibrated such that the steady state of the model matches the long-term properties in the data. In particular, they satisfy the equivalent of the equilibrium conditions without UB and 10 moments: (i) the unemployment rate, 4 percent; (ii) the fraction of formal jobs, 57 percent; (iii) the job finding rate for formal jobs, 8 percent; (iv) the flow from formality to informality, 4 percent; (v) the flow from informality to formality, 5 percent (vi) the job separation rate of informal jobs, 0.8 percent; (vii) the job separation rate of formal jobs, 0.5 percent; (viii) the share of workers in the formal sector that have worked for at least one year, 60 percent;[12] (ix) the elasticity of the job separation rates to productivity changes in the informal sector is three times as large as it is in the formal sector;[13] and (x) market tightness equal to unity, $\theta = 1$.

To the best of our knowledge, there are no estimates of the value of the market tightness in Mexico or in any comparable economies, mainly due to the lack of data on vacancies. Yet, as explained by Shimer (2005), the steady state value of θ is of little importance in the results since varying it only implies a readjustment of the value of η, leaving everything else unchanged. The calibrated values of $\varepsilon^G_{\min}$, $\varepsilon^{H_f}_{\min}$, and $\varepsilon^{H_i}_{\min}$ are 0.49, -1.01, and -0.96, respectively.[14] The values for the remaining four parameters are

for models that study cyclical fluctuations, it is worth introducing our calibration into the context of recent literature.

[10] We perform sensitivity analysis for the value of this parameter. These extra sets of results are not shown in the present paper, but are available from the authors upon request. We find that varying this parameter within a range of $z \in [0.3, 0.7]$ (depending on the value of the UB) does not substantially alter our results concerning the impact of the introduction of the UB system. This is due to two reasons: (i) our analysis focuses on the steady state of the economy and not on cyclical fluctuations; (ii) all types of workers (formal and informal) obtain the value of leisure, z, while unemployed, which implies that the incentives to be employed in the formal or informal sector are not affected by it.

[11] If we assume that there is no UB system in the model, there is no longer a distinction between the states where workers collect or have qualified for UB. Hence, the nine thresholds collapse to only four: ε_R, ε_{D_f}, ε_{D_i}, and ε_T.

[12] This estimate is based on a recent study by Bosch and Kaplan (2012), for the Inter-American Development Bank (IDB). The reason to use this target is that the arrival rate of idiosyncratic productivity shocks in the formal sector, λ_f, affects the dissolution rate of formal matches, and therefore the percentage of workers entering the unemployment pool that have been employed formally for more than a year.

[13] Bosch and Maloney (2008) provide this estimate for Mexico. We use this target since, as shown in Bosch and Esteban-Pretel (2011), which uses a model similar to the one in this paper, increasing the value of arrival rate of idiosyncratic shocks proportionally increases the job separation rate elasticity.

[14] Although not shown explicitly herein, the calibrated lower bound of the initial productivity distribution, $\varepsilon^G_{\min}$, is higher than the threshold at which formal and informal jobs are dissolved. This is required to satisfy the assumption that all initial

$\mu = 0.15$, $k = 0.42$, $F = 4.02$, $\sigma = 84.36$, $\chi = 0.2$, $\lambda_f = 0.1$, and $\lambda_i = 0.3$.

4 Results

The previous section details how the parameter values of the model are selected in order to find the numerical solution of the steady state of the economy. The calibration of the model is targeted to reproduce the main characteristics of the Mexican labor market over the last couple of decades. This requires a version of the model in which the UB is not present, as is currently the case for Mexico, where there is no such government subsidies. This section explains the changes in the steady state equilibrium that would take place following the introduction of a UB system. We look at the shift in incentives of workers and the overall effect on the labor market. We first present the changes due to the introduction of the UB in isolation, and then discuss the effects on the labor market if the UB system is introduced in combination with other government policies, in particular a reduction in firing costs, a decrease in employment taxes, and an increase in informal monitoring.

In order to understand the effects of the UB system within the model, it is worth highlighting the two main mechanisms driving our results. First, there is a tradeoff between the benefit levels and the required contributions. Higher benefits relative to contributions make formal employment and unemployment more attractive states than one of informality. Formal jobs become more desirable as they grant workers access to UB. Unemployment becomes more attractive, relative to informality, because workers can transit more easily to formal jobs, given that search efficiency is higher while unemployed. The second mechanism is related to the reduced incentives to remain formal as workers qualify for collection of UB. Due to low monitoring, workers can claim UB and still work in the informal sector, which makes transitions into informality more likely. The interaction of these two mechanism will ultimately determine the overall effects of the introduction of the UB system on the unemployment rate and the share of formal employment.

4.1 Effects of the Introduction of the UB System

Table 2 displays the steady state of the economy with and without UB. The first thing to note is that the effect of the introduction of UB on the labor market depends on two factors: (i) the replacement rate (the fraction of the average formal wage that the worker collects as UB, that is $b/\tilde{w}_f$, where $\tilde{w}_f$ is the average formal wage), and (ii) the contribution to the UB system (the fraction of the wage paid into the UB system every period that the worker is employed formally, τ_b). These two components have two opposing effects on the incentives of workers and firms.

First, for a given UB contribution, as the replacement rate increases from 30 percent, to 50 percent, to 70 percent of the average formal wage, unemployment increases and so does formality. For instance, for $\tau_b = 2\%$, formality increases from 53.9 percent, to 58.8 percent, to 60.6 percent, while unemployment rises from 4.2 percent, to 4.7 percent, to 5.3 percent, as the replacement rate grows from 30 percent, to 50 percent, to 70 percent, respectively. The increase in both of these variables is fairly intuitive. On the one hand, since only workers who have been employed in the formal sector and have contributed to the UB

contacts between firms and workers result in matches.

system are entitled to collect the benefit, the incentives to become formal increase. The more generous the UB system, the higher the incentives since the opportunity cost of informality, where workers do not contribute to the UB system, and therefore cannot qualify for collection later, becomes more important. This is evident based on the increasing flow rates from both unemployment and informality into formality. At the same time, increasing the generosity of the UB system raises the value of unemployment, which is due to the fact that unemployed workers search for new jobs more efficiently than workers with informal jobs. In line with this, as the UB becomes more generous, there is an increases in flows from informality to unemployment.

Second, for a given replacement rate, greater UB contributions lead to a decrease in both unemployment and formality. For instance, fixing the replacement rate at 50 percent of the average formal wage, as we increase τ_b from 2 percent, to 8.3 percent, to 16.7 percent, we observe a decrease in unemployment from 4.7 percent, to 3.8 percent, to 2.9 percent, and a drop in formality from 58.8 percent, to 54.3 percent, to 46.0 percent. This change in unemployment and formality, as τ_g shifts, responds again to the appropriate incentives of workers. If the replacement rate is kept constant, an increase in UB contributions reduces the after-tax wages of the formal workers, and at the same time increases the wages paid by the firms. This leads to a decrease in the value of formal employment and a rise in the incentives of workers and firms to be informal since no taxes are paid but workers can collect UB for some time. At the same time, since the average value of formal employment drops with the increase in taxes, and given that workers are better off working informally than being unemployed, an increase in UB contributions leads to a more permanent state of informality, and informal workers transition less into unemployment. This is also evidenced by the increased flow rates into informality, both from formality and unemployment. Therefore, raising the UB contributions leads to an increase in the number of informal workers and a decrease in the number of both unemployed and formal workers.

Table 2 also shows the required contributions for the UB system to be fully self-financed by workers and firms. We find that 8.3 percent, 16.7 percent, and 26.6 percent UB contribution rates are required to self-finance the system with 30 percent, 50 percent, and 70 percent replacement rates, respectively. While these rates may seem large for high replacement rates, they provide an idea of the feasibility of such programs if self-funding is a requirement for their implementation.

In sum, we find that the introduction of a UB system into the labor market can lead to either an increase or a decrease in informality, with respect to the market without such a system, depending on the level of the replacement rate and the UB contributions. For low replacement rates, such as 30 percent of the average formal wage, even if UB contributions are as low as 2 percent of wages, we find that formality decreases from 57 percent to 53.9 percent after the introduction of the UB. However, if the replacement rate is generous enough, for instance 50 percent, we can have increases in taxes of up to 4 percent and still observe increases in formality.

4.2 Combining UB Systems with Other Policies

The UB system does not work in isolation in affecting the incentives of both workers and firms, rather it interacts with other policy interventions already in place. In order to study policy complementarity, we combine the introduction of the UB program with the following interventions: (i) a decline in firing costs,

(ii) a drop in employment taxes, and (iii) an increase in government monitoring of the informal sector. This is especially relevant since changes in the UB system are likely to be implemented in combination with other labor market reforms to strengthen their effectiveness.

Lower Firing Costs and UB

Table 3 shows the steady state equilibrium of the economy when firing costs are lowered by 10 percent, from $F = 4.02$ in the baseline calibration to $F = 3.61$. The table illustrates that, when the UB program is introduced in combination with lower firing costs, informality can decrease, even if the UB contributions are not at the lowest levels.

To fully understand this result, the second column of the table shows what can happen when firing costs are lowered, even in an economy with no UB program. We see that lowering firing costs can lead to an increase in unemployment because it becomes easier for firms to dismiss workers. At the same time, given that formal employment has higher average productivity and, now, lower costs, we also observe an increase in formality. This combination dampens the negative effect of increased contributions on formality for every replacement rate, but at the cost of increased unemployment.

Lower Employment Taxes and UB

Table 4 presents the results of a decline in general employment taxes from the baseline level of $\tau_g = 32\%$ to a new lower level 10 percent, $\tau_g = 28.8\%$. As in the case with lowering firing costs, reducing employment taxes leads to increases in formality, and the UB program can be implemented at a higher gain to formality with respect to the baseline case. The institution for this result is similar to that of lowering firing costs. The drop in taxes makes formality more attractive, which reduces informality and raises the unemployment rate because the value of search increases.

Increased Goverment Monitoring of the Informal Sector and UB

Finally, we assess the impact of increased government monitoring of informal jobs in combination with the implementation of a UB system. Table 5 shows the results when the monitoring rate increases by 10 percent, from $\phi = 0.0017$ to $\phi = 0.00187$. Increased government monitoring lowers the value of holding an informal job, which translates into higher flows from informality into unemployment and also into formality, especially after the introduction of the UB system. Overall, this combination can lead to a substantial increase in unemployment and, for high levels of the UB replacement rate, also an increase in the share of formal employment.

5 Conclusions

UB programs are not common in developing countries, especially in Latin America. Several governments in the region are, however, considering the implementation of such systems to try to protect their unemployed workers and provide the labor market with incentives to shift away from informality, which is an important problem that all countries in the region face.

The challenges in the implementation of UB programs in developing economies are different from those being faced by developed nations. In particular, the existence of large informal employment sectors, whose workers are, in general, less protected, less productive, and do not contribute to the tax system, implies that the reaction of the labor market to the introduction of UB may cause changes in workers' behavior that differ from the changes in the behavior of workers in economies with little or no informality.

In order to understand the effects on the labor market of the introduction of UB in economies with a large informal sector, we build a search and matching model with two sectors (formal and informal), endogenous destruction, on-the-job search, and intersectoral flows of workers. The decision to be formal or informal is endogenous in the model, which makes it possible to study how incentives change after the introduction of UB. The UB system is such that formal workers contribute a fraction of their wage to the system while they are employed, and can collect benefits when they lose their jobs. Given the difficulty of monitoring informality, we assume that informal workers can also collect UB. However, it is not possible to collect UB indefinitely.

We parametrize the model for the economy in Mexico, a prime example of a country with high informality and no UB system in place, but which is thinking of introducing such a system. We find that the labor market's reaction to the existence of UB depends on the generosity of the benefits and on the required contributions to finance such a system. Increasing the level of the benefit for a given contribution increases the incentives of workers to remain in the formal sector in order to qualify for collection. At the same time, it reduces informality while also increasing unemployment (as the value of being unemployed increases due to the existence of the UB). On the other hand, if the required contributions increase while the benefits remain unchanged, the UB program becomes less attractive, as does being formal, thus leading to an increase in informality.

We also study the effect of the introduction of the UB program in combination with other interventions, which can lead to reductions in informality. In particular, we show that there is plenty of scope for policy complementarity. For instance, lowering firing costs, lowering employment taxes, or increasing government monitoring of the informal sector can reduce the negative effects on formality caused by the introduction of a UB system. However, all three combinations lead to an increase in the unemployment rate.

References

Acemoglu, D., and R. Shimer (1999): "Efficient Unemployment Insurance," *Journal of Political Economy*, 107(5), 893–928. 2

Albrecht, J., L. Navarro, and S. Vroman (2009): "The Effects of Labour Market Policies in an Economy with an Informal Sector," *The Economic Journal*, 119(539), 1105–1129. 3

Almeida, R., and P. Carneiro (2009): "Enforcement of Labor Regulation and Firm Size," *Journal of Comparative Economics*, 37(1), 28–46. 15

Álvarez-Parra, F., and J. M. Sánchez (2009): "Unemployment Insurance with a Hidden Labor Market," *Journal of Monetary Economics*, 56(7), 954–67. 4

Antunes, A. R., and T. V. de V. Cavalcanti (2007): "Start up Costs, Limited Enforcement, and the Hidden Economy," *European Economic Review*, 51(1), 203–24. 3

Boeri, T., and P. Garibaldi (2006): "Shadow Sorting," CEPR Discussion Papers 5487, C.E.P.R. Discussion Papers. 3

Bosch, M. (2004): "Start up Costs, Informality and Policy Complementarities," Unpublished, London School of Economics. 3

Bosch, M., and J. Esteban-Pretel (2011): "Job Creation and Job Destruction in the Presence of Informal Markets," *Journal of Development Economics*, Forthcoming (doi: 10.1016/j.jdeveco.2011.08.004). 3, 16

Bosch, M., and D. Kaplan (2012): "Meassuring the Cost of Implementing Unemployment Insurance in Mexico: A Naive Estimate," Unpublished, Inter-American Development Bank (IDB), Washington DC. 16

Bosch, M., and W. F. Maloney (2008): "Cyclical Movements in Unemployment and Informality in Developing Countries," *IZA Discussion Paper*, (No. 3514). 2, 4, 16

Cahuc, P., and E. Lehmann (2000): "Should Unemployment Benefits Decrease with the Unemployment Spell?," *Journal of Public Economics*, 77(1), 135–53. 2

Fugazza, M., and J.-F. Jacques (2004): "Labor Market Institutions, Taxation and the Underground Economy," *Journal of Public Economics*, 88(1-2), 395–418. 3

Hagedorn, M., and I. Manovskii (2008): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies Revisited," *The American Economic Review*, 98(4), 1692–1706. 16

ILO (2000): "World Labour Report 2000: Income Security and Social Protection in a Changing World," *International Labour Office, Geneva.* 2

Kugler, A. D. (1999): "The Impact of Firing Costs on Turnover and Unemployment: Evidence from the Colombian Labour Market Reform," *International Tax and Public Finance*, 6, 389–410, 10.1023/A:1008711819429. 3

Margolis, D. N., L. Navarro, and D. A. Robalino (2012): "Unemployment Insurance, Job Search and Informal Employment," IZA Discussion Papers 6660, Institute for the Study of Labor (IZA). 3

Mortensen, D. T., and C. A. Pissarides (1994): "Job Creation and Job Destruction in the Theory of Unemployment," *The Review of Economic Studies*, 61(3), 397–415. 4

Pagés, C., and M. Stampini (2009): "No Education, No Good Jobs? Evidence on the Relationship between Education and Labor Market Segmentation," *Journal of Comparative Economics*, 37(3), 387–401. 2

Petrongolo, B., and C. A. Pissarides (2001): "Looking into the Black Box: A Survey of the Matching Function," *Journal of Economic Literature*, 39(2), 390–431. 15

Pissarides, C. A. (1983): "Efficiency Aspects of the Financing of Unemployment Insurance and Other Government Expenditure," *The Review of Economic Studies*, 50(1), 57–69. 2

Shimer, R. (2005): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies," *The American Economic Review*, 95(1), 25–49. 16

Zenou, Y. (2008): "Job Search and Mobility in Developing Countries: Theory and Policy Implications," *Journal of Development Economics*, 86(2), 336–355. 3

Appendix A Data Details

Data for Mexico are drawn from the National Survey of Urban Employment (Encuesta Nacional de Empleo Urbano, or ENEU), which conducts quarterly household interviews in the 16 major metropolitan areas. The questionnaire is extensive in areas traditionally found in such employment surveys, such as participation in the labor market, wages, hours worked, etcetera. The ENEU is structured to track one-fifth of each sample across a five-quarter period. We have concatenated panels from the first quarter of 1987 to the first quarter of 2004. Starting in the first quarter of 2005, the ENEU was expanded to rural areas to make it nationally representative and was renamed as the National Survey on Occupation and Employment (Encuesta Nacional de Ocupacion y Empleo, or ENOE). The ENEU-ENOE has suffered only minor modifications during the covered period, but it has substantially changed its geographical coverage. From 1988 to 1992, the survey comprised 16 major urban areas. In 1992, 18 more urban areas were added, and by the beginning of 1998, 44 cities were included in the sample. The sample is constrained to the original 16 cities, although all results are similar with the extended sample. We broadly follow the International Labor Organization (ILO) definition of informality by dividing employed workers into two sectors: formal and informal, which we classify on the basis of lack of compliance with labor legislation. In particular, we use the lack of contributions by the employer to the social security agency, IMSS (or the equivalent for civil servants, IMSTS), as the critical distinguishing characteristic. We also consider informal workers, self-employed workers (excluding professionals and technicians), and owners of microfirms (five employees or less) to have no social security contributions. Owners of medium or large firms (more than five employees) and professionals and technicians that are self-employed and/or that make with social security contributions are all considered formal.

Appendix B Model Equations

Here, we write the expressions for the surpluses, wages, and thresholds, which are not explicitly stated in the main body of the paper.

Surpluses and Wages

Formal match with a new worker who was collecting unemployment benefits (UB)
The value of the surplus is

$$
\begin{aligned}
\left(r+\lambda_f+\varphi+\chi\theta q\left(\theta\right)\right) S_f^{n_b}\left(\varepsilon\right) = \;& p+\varepsilon-b-z-\left(\tau_g^f+\tau_g^w\right) w_f^{n_b}\left(\varepsilon\right)-\left(\tau_b^f+\tau_b^w\right)-\left(r+\lambda_f+\varphi+\chi\theta q\left(\theta\right)\right) c \\
& -\left(\lambda_f+\varphi\right) F+\left(\lambda_f+\chi\theta q\left(\theta\right)+\rho\right)\left(U^b-U^z\right) \\
& +\lambda_f\left\{\int_{\varepsilon_{D_f}^z}^{\varepsilon_T^z} S_i^z\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^z}^{\varepsilon_{\max}^{H_f}} S_f^{o_z}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right\} \\
& -\left(1-\chi\right)\theta q(\theta)\left\{\beta_i \int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z\left(\varepsilon'\right) dG\left(\varepsilon'\right)+\hat{\beta}_f \int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
& +\varphi\left[\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b} S_i^b\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^b}^{\varepsilon_{\max}^{H_f}} S_f^{o_b}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right],
\end{aligned}
$$

and the wage is

$$
\begin{aligned}
w_f^{n_b}\left(\varepsilon\right) = \;& \frac{\beta_f}{1+\tau_g^f}\left\{p+\varepsilon-\tau_b^f-\left(r+\lambda_f+\varphi+\chi\theta q\left(\theta\right)\right) c-\left(\lambda_f+\varphi\right) F\right\} \\
& -\frac{1-\beta_f}{1+\tau_g^w}\left\{-\tau_b^w-b-z-\left(\lambda_f+\chi\theta q\left(\theta\right)+\rho\right)\left(U^b-U^z\right)\right\} \\
& \frac{1-\beta_f}{1+\tau_g^w}\left(1-\chi\right)\theta q(\theta)\left\{\beta_i \int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z\left(\varepsilon'\right) dG\left(\varepsilon'\right)+\hat{\beta}_f \int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
& +\left[\frac{\beta_f\left(1-\beta_i\right)}{1+\tau_g^f}-\frac{\left(1-\beta_f\right)\beta_i}{1+\tau_g^w}\right]\left[\lambda_f \int_{\varepsilon_{D_f}^z}^{\varepsilon_T^z} S_i^z\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\varphi \int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b} S_i^b\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right].
\end{aligned}
$$

Formal match with a new worker who was not collecting UB
The surplus is

$$
\begin{aligned}
\left(r+\lambda_f+\varphi+\chi\theta q(\theta)\right) S_f^{n_z}(\varepsilon) &= p+\varepsilon-z-\left(\tau_g^f+\tau_g^w\right) w_f^{n_z}(\varepsilon)-\left(\tau_b^f+\tau_b^w\right)-\left(r+\lambda_f+\varphi+\chi\theta q(\theta)\right) c \\
&-\left(\lambda_f+\varphi\right) F+\varphi\left(U^b-U^z\right) \\
&+\lambda_f\left\{\int_{\varepsilon_f^z}^{\varepsilon_T^z} S_i^z\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^z}^{\varepsilon_{\max}^{H_f}} S_f^{o_z}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right\} \\
&-(1-\chi)\,\theta q(\theta)\left\{\beta_i \int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z\left(\varepsilon'\right) dG\left(\varepsilon'\right)+\hat{\beta}_f \int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
&+\varphi\left[\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b} S_i^b\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^b}^{\varepsilon_{\max}^{H_f}} S_f^{o_b}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right]
\end{aligned}
$$

and the wage paid to workers in such matches is

$$
\begin{aligned}
w_f^{n_z}(\varepsilon) &= \frac{\beta_f}{1+\tau_g^f}\left\{p+\varepsilon-\tau_b^f-\left(r+\lambda_f+\varphi+\chi\theta q(\theta)\right) c-\left(\lambda_f+\varphi\right) F\right\}-\frac{1-\beta_f}{1+\tau_g^w}\left\{-\tau_b^w-z\right\} \\
&+\frac{1-\beta_f}{1+\tau_g^w}(1-\chi)\,\theta q(\theta)\left\{\beta_i \int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z\left(\varepsilon'\right) dG\left(\varepsilon'\right)+\hat{\beta}_f \int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
&+\left[\frac{\beta_f\left(1-\beta_i\right)}{1+\tau_g^f}-\frac{\left(1-\beta_f\right) \beta_i}{1+\tau_g^w}\right]\left[\lambda_f \int_{\varepsilon_{D_f}^z}^{\varepsilon_T^z} S_i^z\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\varphi \int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b} S_i^b\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right]
\end{aligned}
$$

Formal match with a new worker who has qualified for UB

The value of the surplus is

$$
\begin{aligned}
\left(r+\lambda_f+\chi\theta q(\theta)\right) S_f^{n_q}(\varepsilon) &= p+\varepsilon-b-z-\left(\tau_g^f+\tau_g^w\right) w_f^{n_q}(\varepsilon)-\left(\tau_b^f+\tau_b^w\right)-\left(r+\lambda_f+\chi\theta q(\theta)\right) c \\
&-\lambda_f F+\rho\left(U^b-U^z\right) \\
&+\lambda_f\left\{\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b} S_i^b\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^b}^{\varepsilon_{\max}^{H_f}} S_f^{o_b}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right\} \\
&+\chi\theta q(\theta)\left\{\beta_i \int_{\varepsilon_{\min}^G}^{\varepsilon_R^q} S_i^b\left(\varepsilon'\right) dG\left(\varepsilon'\right)+\hat{\beta}_f \int_{\varepsilon_R^q}^{\varepsilon_{\max}^{H_f}} S_f^{n_q}\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
&-\theta q(\theta)\left\{\beta_i \int_{\varepsilon_{\min}^G}^{\varepsilon_R^b} S_i^b\left(\varepsilon'\right) dG\left(\varepsilon'\right)+\hat{\beta}_f \int_{\varepsilon_R^b}^{\varepsilon_{\max}^{H_f}} S_f^{n_b}\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\},
\end{aligned}
$$

and the wage is

$$\begin{aligned} w_f^{n_q}(\varepsilon) &= \frac{\beta_f}{1+\tau_g^f}\left\{p+\varepsilon-\tau_b^f-(r+\lambda_f+\chi\theta q(\theta))c-\lambda_f F\right\}-\frac{1-\beta_f}{1+\tau_g^w}\left\{-\tau_b^w-b-z-\rho\left(U^z-U^b\right)\right\} \\ &-\frac{1-\beta_f}{1+\tau_g^w}\chi\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^q}S_i^b(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^q}^{\varepsilon_{\max}^{H_f}}S_f^{n_q}(\varepsilon')\,dG(\varepsilon')\right\} \\ &+\frac{1-\beta_f}{1+\tau_g^w}\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^b}S_i^b(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^b}^{\varepsilon_{\max}^{H_f}}S_f^{n_b}(\varepsilon')\,dG(\varepsilon')\right\} \\ &+\lambda_f\left[\frac{\beta_f(1-\beta_i)}{1+\tau_g^f}-\frac{(1-\beta_f)\beta_i}{1+\tau_g^w}\right]\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b}S_i^b(\varepsilon')\,dH_f(\varepsilon') \end{aligned}$$

Formal match with an on-going worker who has qualified for UB
The value of the surplus is

$$\begin{aligned} (r+\lambda_f+\chi\theta q(\theta))S_f^{o_b}(\varepsilon) &= p+\varepsilon-b-z-\left(\tau_g^f+\tau_g^w\right)w_f^{o_b}(\varepsilon)-\left(\tau_b^f+\tau_b^w\right)+(r+\chi\theta q(\theta))F+\rho\left(U^b-U^z\right) \\ &+\lambda_f\left\{\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b}S_i^b(\varepsilon')\,dH_f(\varepsilon')+\int_{\varepsilon_T^b}^{\varepsilon_{\max}^{H_f}}S_f^{o_b}(\varepsilon')\,dH_f(\varepsilon')\right\} \\ &+\chi\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^q}S_i^b(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^q}^{\varepsilon_{\max}^{H_f}}S_f^{n_q}(\varepsilon')\,dG(\varepsilon')\right\} \\ &-\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^b}S_i^b(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^b}^{\varepsilon_{\max}^{H_f}}S_f^{n_b}(\varepsilon')\,dG(\varepsilon')\right\}, \end{aligned}$$

and the wage paid to the worker is

$$\begin{aligned} w_f^{o_b}(\varepsilon) &= \frac{\beta_f}{1+\tau_g^f}\left\{p+\varepsilon-\tau_b^f+(r+\chi\theta q(\theta))F\right\}-\frac{1-\beta_f}{1+\tau_g^w}\left\{-\tau_b^w-b-z-\rho\left(U^z-U^b\right)\right\} \\ &-\frac{1-\beta_f}{1+\tau_g^w}\chi\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^q}S_i^b(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^q}^{\varepsilon_{\max}^{H_f}}S_f^{n_q}(\varepsilon')\,dG(\varepsilon')\right\} \\ &+\frac{1-\beta_f}{1+\tau_g^w}\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^b}S_i^b(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^b}^{\varepsilon_{\max}^{H_f}}S_f^{n_b}(\varepsilon')\,dG(\varepsilon')\right\} \\ &+\lambda_f\left[\frac{\beta_f(1-\beta_i)}{1+\tau_g^f}-\frac{(1-\beta_f)\beta_i}{1+\tau_g^w}\right]\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b}S_i^b(\varepsilon')\,dH_f(\varepsilon') \end{aligned}$$

Formal match with an on-going worker who has not qualified for UB
The value of the surplus is

$$
\begin{aligned}
\left(r+\lambda_f+\varphi+\chi\theta q\left(\theta\right)\right)S_f^{o_z}\left(\varepsilon\right) &= p+\varepsilon-z-\left(\tau_g^f+\tau_g^w\right)w_f^{o_z}\left(\varepsilon\right)-\left(\tau_b^f+\tau_b^w\right)+\left(r+\chi\theta q\left(\theta\right)\right)F+\varphi\left(U^b-U^z\right)\\
&+\lambda_f\left\{\int_{\varepsilon_{D_f}^z}^{\varepsilon_T^z}S_i^z\left(\varepsilon'\right)dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^z}^{\varepsilon_{\max}^{H_f}}S_f^{o_z}\left(\varepsilon'\right)dH_f\left(\varepsilon'\right)\right\}\\
&-\left(1-\chi\right)\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^z}S_i^z\left(\varepsilon'\right)dG\left(\varepsilon'\right)+\hat{\beta}_f\int_{\varepsilon_R^z}^{\varepsilon_{\max}^G}S_f^{n_z}\left(\varepsilon'\right)dG\left(\varepsilon'\right)\right\}\\
&+\varphi\left[\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b}S_i^b\left(\varepsilon'\right)dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^b}^{\varepsilon_{\max}^{H_f}}S_f^{o_b}\left(\varepsilon'\right)dH_f\left(\varepsilon'\right)\right],
\end{aligned}
$$

and the wage that the worker is paid is

$$
\begin{aligned}
w_f^{o_z}\left(\varepsilon\right) &= \frac{\beta_f}{1+\tau_g^f}\left\{p+\varepsilon-\tau_b^f+\left(r+\chi\theta q\left(\theta\right)\right)F\right\}-\frac{1-\beta_f}{1+\tau_g^w}\left\{-\tau_b^w-z-\varphi\left(U^b-U^z\right)\right\}\\
&+\frac{1-\beta_f}{1+\tau_g^w}\left(1-\chi\right)\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^z}S_i^z\left(\varepsilon'\right)dG\left(\varepsilon'\right)+\hat{\beta}_f\int_{\varepsilon_R^z}^{\varepsilon_{\max}^G}S_f^{n_z}\left(\varepsilon'\right)dG\left(\varepsilon'\right)\right\}\\
&+\left[\frac{\beta_f\left(1-\beta_i\right)}{1+\tau_g^f}-\frac{\left(1-\beta_f\right)\beta_i}{1+\tau_g^w}\right]\left[\lambda_f\int_{\varepsilon_{D_f}^z}^{\varepsilon_T^z}S_i^z\left(\varepsilon'\right)dH_f\left(\varepsilon'\right)+\varphi\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b}S_i^b\left(\varepsilon'\right)dH_f\left(\varepsilon'\right)\right].
\end{aligned}
$$

Match with an informal worker who collects UB
The value of the surplus is

$$
\begin{aligned}
\left(r+\lambda_i+\chi\theta q\left(\theta\right)+\rho+\phi\right)S_i^b\left(\varepsilon\right) &= p+\varepsilon-z-\phi\sigma-\phi\left(U^b-U^z\right)\\
&+\lambda_i\left[\int_{\varepsilon_{D_i}^b}^{\varepsilon_R^b}S_i^b\left(\varepsilon'\right)dH_i\left(\varepsilon'\right)+\int_{\varepsilon_R^b}^{\varepsilon_{\max}^{H_i}}S_f^{n_b}\left(\varepsilon'\right)dH_i\left(\varepsilon'\right)\right]\\
&+\rho\left[\int_{\varepsilon_{D_i}^z}^{\varepsilon_R^z}S_i^z\left(\varepsilon'\right)dH_i\left(\varepsilon'\right)+\int_{\varepsilon_R^z}^{\varepsilon_{\max}^{H_i}}S_f^{n_z}\left(\varepsilon'\right)dH_i\left(\varepsilon'\right)\right]\\
&-\left(1-\chi\right)\theta q\left(\theta\right)\left[\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^b}S_i^b\left(\varepsilon'\right)dG\left(\varepsilon'\right)+\hat{\beta}_f\int_{\varepsilon_R^b}^{\varepsilon_{\max}^G}S_f^{n_b}\left(\varepsilon'\right)dG\left(\varepsilon'\right)\right],
\end{aligned}
$$

and the wage is

$$
\begin{aligned}
w_i^b\left(\varepsilon\right) &= \beta_i\left\{p+\varepsilon-\phi\sigma\right\}+\left(1-\beta_i\right)\left\{b+z+\phi\left(U^b-U^z\right)\right\}\\
&+\left(1-\beta_i\right)\left(1-\chi\right)\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^b}S_i^b dG\left(\varepsilon'\right)+\hat{\beta}_f\int_{\varepsilon_R^b}^{\varepsilon_{\max}^G}S_f^{n_b}dG\left(\varepsilon'\right)\right\}\\
&+\lambda_i\left(\beta_i-\hat{\beta}_f\right)\int_{\varepsilon_R^b}^{\varepsilon_{\max}^{H_i}}S_f^{n_b}\left(\varepsilon'\right)dH_i\left(\varepsilon'\right)+\rho\left(\beta_i-\hat{\beta}_f\right)\int_{\varepsilon_R^z}^{\varepsilon_{\max}^{H_i}}S_f^{n_z}\left(\varepsilon'\right)dH_i\left(\varepsilon'\right).
\end{aligned}
$$

Match with an informal worker who does not collect UB

The value of the surplus is

$$
\begin{aligned}
\left(r+\lambda_i+\chi\theta q(\theta)+\phi\right)S_i^z(\varepsilon) &= p+\varepsilon-z-\phi\sigma \\
&+\lambda_i\left[\int_{\varepsilon_{D_i}^z}^{\varepsilon_R^z} S_i^z(\varepsilon')\,dH_i(\varepsilon')+\int_{\varepsilon_R^z}^{\varepsilon_{\max}^{H_i}} S_f^{n_z}(\varepsilon')\,dH_i(\varepsilon')\right] \\
&-(1-\chi)\,\theta q(\theta)\left[\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}(\varepsilon')\,dG(\varepsilon')\right],
\end{aligned}
$$

and the wage is

$$
\begin{aligned}
w_i^z(\varepsilon) &= \beta_i\left\{p+\varepsilon-\phi\sigma\right\}+(1-\beta_i)\,z \\
&+(1-\beta_i)(1-\chi)\,\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}(\varepsilon')\,dG(\varepsilon')\right\} \\
&+\lambda_i\left(\beta_i-\hat{\beta}_f\right)\int_{\varepsilon_R^z}^{\varepsilon_{\max}^{H_i}} S_f^{o_z}(\varepsilon')\,dH_i(\varepsilon').
\end{aligned}
$$

Thresholds

We now state the expressions for the seven thresholds of the model, as well as the conditions that determine them.

Destruction thresholds

1. We can find $\varepsilon_{D_i}^b$, using the condition $J_i^b\left(\varepsilon_{D_i}^b\right)=0$ or $S_i^b\left(\varepsilon_{D_i}^b\right)=0$. The expression for this threshold is:

$$
\begin{aligned}
0 &= p+\varepsilon_{D_i}^b-z-\phi\sigma-\phi\left(U^b-U^z\right)+\lambda_i\left[\int_{\varepsilon_{D_i}^b}^{\varepsilon_R^b} S_i^b(\varepsilon')\,dH_i(\varepsilon')+\int_{\varepsilon_R^b}^{\varepsilon_{\max}^{H_i}} S_f^{n_b}(\varepsilon')\,dH_i(\varepsilon')\right] \\
&+\rho\left[\int_{\varepsilon_{D_i}^z}^{\varepsilon_R^z} S_i^z(\varepsilon')\,dH_i(\varepsilon')+\int_{\varepsilon_R^z}^{\varepsilon_{\max}^{H_i}} S_f^{n_z}(\varepsilon')\,dH_i(\varepsilon')\right] \\
&-(1-\chi)\,\theta q(\theta)\left[\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^b} S_i^b(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^b}^{\varepsilon_{\max}^G} S_f^{n_b}(\varepsilon')\,dG(\varepsilon')\right]
\end{aligned}
$$

2. We can find $\varepsilon_{D_i}^z$, using the condition $J_i^z\left(\varepsilon_{D_i}^z\right)=0$ or $S_i^z\left(\varepsilon_{D_i}^z\right)=0$. The expression for this threshold is:

$$
\begin{aligned}
0 &= p+\varepsilon_{D_i}^z-z-\phi\sigma+\lambda_i\left[\int_{\varepsilon_{D_i}^z}^{\varepsilon_R^z} S_i^z(\varepsilon')\,dH_i(\varepsilon')+\int_{\varepsilon_R^z}^{\varepsilon_{\max}^{H_i}} S_f^{n_z}(\varepsilon')\,dH_i(\varepsilon')\right] \\
&-(1-\chi)\,\theta q(\theta)\left[\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z(\varepsilon')\,dG(\varepsilon')+\hat{\beta}_f\int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}(\varepsilon')\,dG(\varepsilon')\right]
\end{aligned}
$$

3. We find $\varepsilon^b_{D_f}$ from the condition

$$\varepsilon^b_{D_f} = max\left\{\varepsilon^{o_b}_f, \varepsilon^b_{D_i}\right\},$$

where $\varepsilon^{o_b}_f$ is obtained using the condition that $J^{o_b}_f\left(\varepsilon^{o_b}_f\right) + F = 0$ or $S^{o_b}_f\left(\varepsilon^{o_b}_f\right) = 0$, and has the form

$$\begin{aligned}
0 &= p + \varepsilon^{o_b}_f - b - z - \left(\tau^f_g + \tau^w_g\right) w^{o_b}_f\left(\varepsilon^{o_b}_f\right) - \left(\tau^f_b + \tau^w_b\right) + \left(r + \chi\theta q\left(\theta\right)\right) F + \rho\left(U^b - U^z\right) \\
&+\lambda_f\left\{\int_{\varepsilon^b_{D_f}}^{\varepsilon^b_T} S^b_i\left(\varepsilon'\right) dH_f\left(\varepsilon'\right) + \int_{\varepsilon^b_T}^{\varepsilon^{H_f}_{\max}} S^{o_b}_f\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right\} \\
&+\chi\theta q(\theta)\left\{\beta_i\int_{\varepsilon^G_{\min}}^{\varepsilon^q_R} S^b_i\left(\varepsilon'\right) dG\left(\varepsilon'\right) + \hat{\beta}_f\int_{\varepsilon^q_R}^{\varepsilon^{H_f}_{\max}} S^{n_q}_f\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
&-\theta q(\theta)\left\{\beta_i\int_{\varepsilon^G_{\min}}^{\varepsilon^b_R} S^b_i\left(\varepsilon'\right) dG\left(\varepsilon'\right) + \hat{\beta}_f\int_{\varepsilon^b_R}^{\varepsilon^{H_f}_{\max}} S^{n_b}_f\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\}
\end{aligned}$$

4. We find $\varepsilon^z_{D_f}$ from the condition

$$\varepsilon^z_{D_f} = max\left\{\varepsilon^{o_z}_f, \varepsilon^z_{D_i}\right\},$$

where $\varepsilon^{o_z}_f$ is obtained using the condition that $J^{o_z}_f\left(\varepsilon^{o_z}_f\right) + F = 0$ or $S^{o_z}_f\left(\varepsilon^{o_z}_f\right) = 0$, and has the form

$$\begin{aligned}
0 &= p + \varepsilon^{o_z}_f - z - \left(\tau^f_g + \tau^w_g\right) w^{o_z}_f\left(\varepsilon^{o_z}_f\right) - \left(\tau^f_b + \tau^w_b\right) + \left(r + \chi\theta q\left(\theta\right)\right) F + \varphi\left(U^b - U^z\right) \\
&+\lambda_f\left\{\int_{\varepsilon^z_f}^{\varepsilon^z_T} S^z_i\left(\varepsilon'\right) dH_f\left(\varepsilon'\right) + \int_{\varepsilon^z_T}^{\varepsilon^{H_f}_{\max}} S^{o_z}_f\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right\} \\
&-\left(1-\chi\right)\theta q(\theta)\left\{\beta_i\int_{\varepsilon^G_{\min}}^{\varepsilon^z_R} S^z_i\left(\varepsilon'\right) dG\left(\varepsilon'\right) + \hat{\beta}_f\int_{\varepsilon^z_R}^{\varepsilon^G_{\max}} S^{n_z}_f\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
&+\varphi\left[\int_{\varepsilon^b_f}^{\varepsilon^b_T} S^b_i\left(\varepsilon'\right) dH_f\left(\varepsilon'\right) + \int_{\varepsilon^b_T}^{\varepsilon^{H_f}_{\max}} S^{o_b}_f\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right]
\end{aligned}$$

Formality-informality thresholds

1. We can obtain ε^b_R, using the condition $J^{n_b}_f\left(\varepsilon^b_R\right) - c = J^b_i\left(\varepsilon^b_R\right)$ or $\left(1-\hat{\beta}_f\right) S^{n_b}_f\left(\varepsilon^b_R\right) = \left(1-\beta_i\right) S^b_i\left(\varepsilon^b_R\right)$. The expression for this threshold is:

$$\left(1-\hat{\beta}_f\right)\frac{1}{r+\lambda_f+\varphi+\chi\theta q\left(\theta\right)}\frac{1-\beta_f\left(\tau^f_g+\tau^w_g\right)}{1+\tau^f_g}\left(\varepsilon^b_R - \varepsilon^{n_b}_f\right) = \left(1-\beta_i\right)\frac{1}{r+\lambda_i+\chi\theta q\left(\theta\right)+\phi}\left(\varepsilon^b_R - \varepsilon^b_{D_i}\right).$$

where $\varepsilon^{n_b}_f$ is found using the condition $J^{n_b}_f\left(\varepsilon^{n_b}_f\right) + F = 0$ or $S^{n_b}_f\left(\varepsilon^{n_b}_f\right) = 0$, and has the following form:

$$
\begin{aligned}
0 \;=\;& p+\varepsilon_f^{n_b}-b-z-\left(\tau_g^f+\tau_g^w\right) w_f^{n_b}\left(\varepsilon_f^{n_b}\right)-\left(\tau_b^f+\tau_b^w\right)-\left(r+\lambda_f+\varphi+\chi\theta q(\theta)\right) c \\
& -\left(\lambda_f+\varphi\right) F+\left(\lambda_f+\chi\theta q(\theta)+\rho\right)\left(U^b-U^z\right) \\
& +\lambda_f\left\{\int_{\varepsilon_f^z}^{\varepsilon_T^z} S_i^z\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^z}^{\varepsilon_{\max}^{H_f}} S_f^{o_z}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right\} \\
& -(1-\chi)\,\theta q(\theta)\left\{\beta_i \int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z\left(\varepsilon'\right) dG\left(\varepsilon'\right)+\hat{\beta}_f \int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
& +\varphi\left[\int_{\varepsilon_f^b}^{\varepsilon_T^b} S_i^b\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^b}^{\varepsilon_{\max}^{H_f}} S_f^{o_b}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right].
\end{aligned}
$$

2. We can obtain ε_R^z, using the condition $J_f^{n_z}(\varepsilon_R^z)-c=J_i^z(\varepsilon_R^z)$ or $\left(1-\hat{\beta}_f\right) S_f^{n_z}(\varepsilon_R^z)=(1-\beta_i) S_i^z(\varepsilon_R^z)$. The expression for this threshold is:

$$
\left(1-\hat{\beta}_f\right) \frac{1}{r+\lambda_f+\varphi+\chi\theta q(\theta)} \frac{1-\beta_f\left(\tau_g^f+\tau_g^w\right)}{1+\tau_g^f}\left(\varepsilon_R^z-\varepsilon_f^{n_z}\right) \;=\; (1-\beta_i) \frac{1}{r+\lambda_i+\chi\theta q(\theta)+\phi}\left(\varepsilon_R^z-\varepsilon_{D_i}^z\right),
$$

where $\varepsilon_f^{n_z}$ is derived using the condition $J_f^{n_z}\left(\varepsilon_f^{n_z}\right)+F=0$ or $S_f^{n_z}\left(\varepsilon_f^{n_z}\right)=0$, and has the following form:

$$
\begin{aligned}
0 \;=\;& p+\varepsilon_f^{n_z}-z-\left(\tau_g^f+\tau_g^w\right) w_f^{n_z}\left(\varepsilon_f^{n_z}\right)-\left(\tau_b^f+\tau_b^w\right)-\left(r+\varphi+\lambda_f+\chi\theta q(\theta)\right) c-\left(\lambda_f+\varphi\right) F+\varphi\left(U^b-U^z\right) \\
& +\lambda_f\left\{\int_{\varepsilon_f^z}^{\varepsilon_T^z} S_i^z\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^z}^{\varepsilon_{\max}^{H_f}} S_f^{o_z}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right\} \\
& -(1-\chi)\,\theta q(\theta)\left\{\beta_i \int_{\varepsilon_{\min}^G}^{\varepsilon_R^z} S_i^z\left(\varepsilon'\right) dG\left(\varepsilon'\right)+\hat{\beta}_f \int_{\varepsilon_R^z}^{\varepsilon_{\max}^G} S_f^{n_z}\left(\varepsilon'\right) dG\left(\varepsilon'\right)\right\} \\
& +\varphi\left[\int_{\varepsilon_f^b}^{\varepsilon_T^b} S_i^b\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^b}^{\varepsilon_{\max}^{H_f}} S_f^{o_b}\left(\varepsilon'\right) dH_f\left(\varepsilon'\right)\right].
\end{aligned}
$$

3. We can find ε_R^q, using the condition $J_f^{n_q}(\varepsilon_R^q)-c=J_i^b(\varepsilon_R^q)$ or $\left(1-\hat{\beta}_f\right) S_f^{n_q}(\varepsilon_R^q)=(1-\beta_i) S_i^b(\varepsilon_R^q)$. The expression for this threshold is:

$$
\left(1-\hat{\beta}_f\right) \frac{1}{r+\lambda_f+\chi\theta q(\theta)} \frac{1-\beta_f\left(\tau_g^f+\tau_g^w\right)}{1+\tau_g^f}\left(\varepsilon_R^q-\varepsilon_f^{n_q}\right) \;=\; (1-\beta_i) \frac{1}{r+\lambda_i+\chi\theta q(\theta)+\phi}\left(\varepsilon_R^q-\varepsilon_{D_i}^b\right),
$$

where $\varepsilon_f^{n_q}$ is found using the condition $J_f^{n_q}\left(\varepsilon_f^{n_q}\right)+F=0$ or $S_f^{n_q}\left(\varepsilon_f^{n_q}\right)=0$, and has the following form:

$$
\begin{aligned}
0 &= p+\varepsilon_f^{n_q}-b-z-\left(\tau_g^f+\tau_g^w\right)w_f^{n_q}\left(\varepsilon_f^{n_q}\right)-\left(\tau_b^f+\tau_b^w\right)-\left(r+\lambda_f+\chi\theta q\left(\theta\right)\right)c-\lambda_f F+\rho\left(U^b-U^z\right)\\
&+\lambda_f\left\{\int_{\varepsilon_{D_f}^b}^{\varepsilon_T^b} S_i^b\left(\varepsilon'\right)dH_f\left(\varepsilon'\right)+\int_{\varepsilon_T^b}^{\varepsilon_{\max}^{H_f}} S_f^{o_b}\left(\varepsilon'\right)dH_f\left(\varepsilon'\right)\right\}\\
&+\chi\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^q} S_i^b\left(\varepsilon'\right)dG\left(\varepsilon'\right)+\hat{\beta}_f\int_{\varepsilon_R^q}^{\varepsilon_{\max}^{H_f}} S_f^{n_q}\left(\varepsilon'\right)dG\left(\varepsilon'\right)\right\}\\
&-\theta q(\theta)\left\{\beta_i\int_{\varepsilon_{\min}^G}^{\varepsilon_R^b} S_i^b\left(\varepsilon'\right)dG\left(\varepsilon'\right)+\hat{\beta}_f\int_{\varepsilon_R^b}^{\varepsilon_{\max}^{H_f}} S_f^{n_b}\left(\varepsilon'\right)dG\left(\varepsilon'\right)\right\}.
\end{aligned}
$$

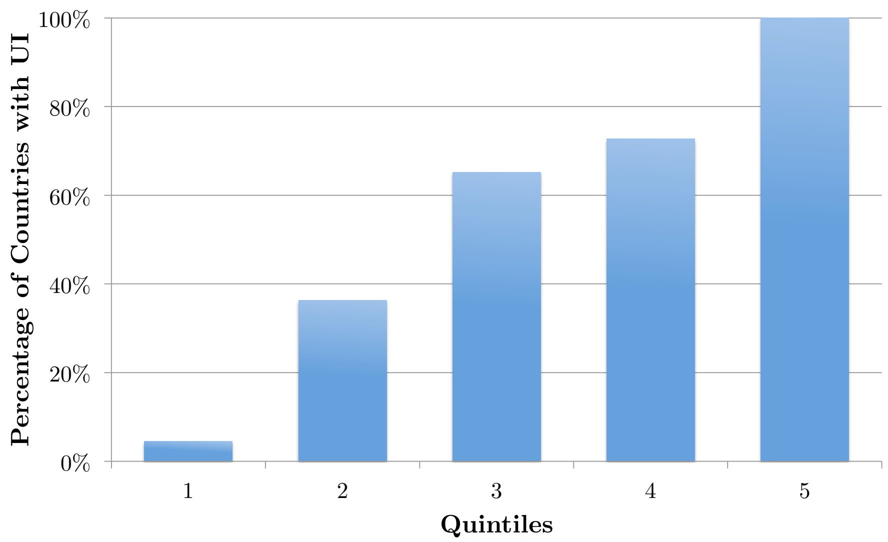
4. We can derive ε_T^b, using the condition $J_f^{o_b}\left(\varepsilon_T^b\right)+F=J_i^b\left(\varepsilon_T^b\right)$ or $\left(1-\hat{\beta}_f\right)S_f^{o_b}\left(\varepsilon_T^b\right)=\left(1-\beta_i\right)S_i^b\left(\varepsilon_T^b\right)$. The expression for this threshold is:

$$
\left(1-\hat{\beta}_f\right)\frac{1}{r+\lambda_f+\chi\theta q\left(\theta\right)}\frac{1-\beta_f\left(\tau_g^f+\tau_g^w\right)}{1+\tau_g^f}\left(\varepsilon_T^b-\varepsilon_f^{o_b}\right) = \left(1-\beta_i\right)\frac{1}{r+\lambda_i+\chi\theta q\left(\theta\right)+\phi}\left(\varepsilon_T^b-\varepsilon_{D_i}^b\right)
$$

5. We can find ε_T^z by using the condition $J_f^{o_z}\left(\varepsilon_T^z\right)+F=J_i^z\left(\varepsilon_T^z\right)$ or $\left(1-\hat{\beta}_f\right)S_f^{o_z}\left(\varepsilon_T^z\right)=\left(1-\beta_i\right)S_i^z\left(\varepsilon_T^z\right)$. The expression for this threshold is:

$$
\left(1-\hat{\beta}_f\right)\frac{1}{r+\lambda_f+\varphi+\chi\theta q\left(\theta\right)}\frac{1-\beta_f\left(\tau_g^f+\tau_g^w\right)}{1+\tau_g^f}\left(\varepsilon_T^z-\varepsilon_f^{o_z}\right) = \left(1-\beta_i\right)\frac{1}{r+\lambda_i+\chi\theta q\left(\theta\right)+\phi}\left(\varepsilon_T^z-\varepsilon_{D_i}^z\right)
$$

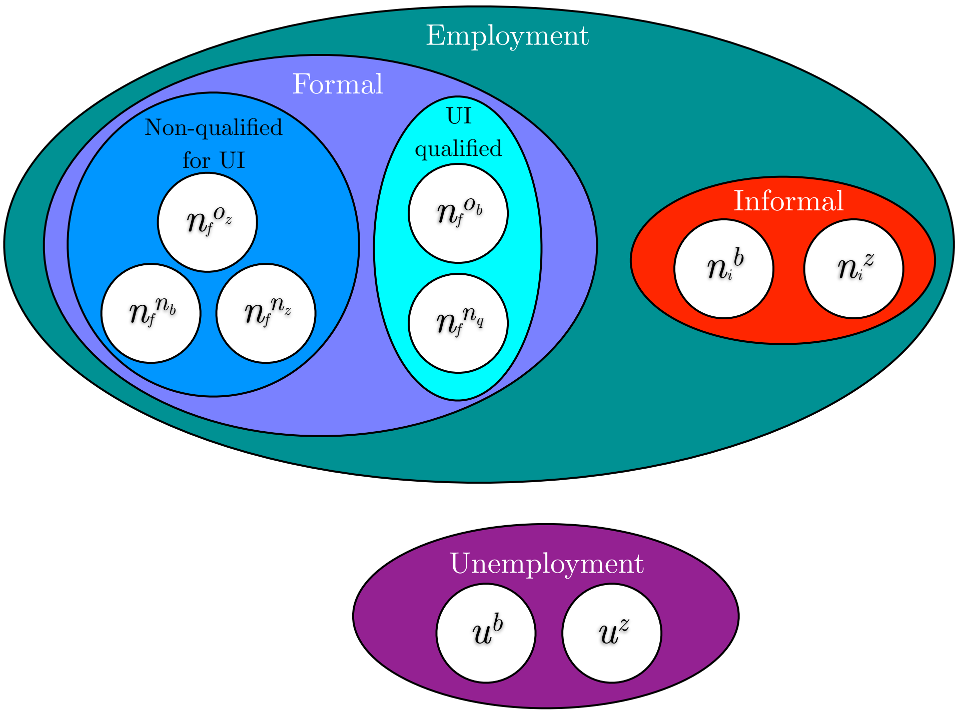
Figure 1: Unemployment Benefits Availability by GDP per Capita Quintiles



Notes: This figures illustrates the percentage of countries that have some type of UB system ordered by quintiles of GDP per capita.

Source: International Labor Organization (ILO) general statistics.

Figure 2: Labor Force Structure and Possible States for Workers



Source: Authors' elaboration.

Table 1: Parameter Values

Exogenous Parameters		
Discount factor	r	0.005
Exponent in the matching function	ξ	0.5
Bargaining power of formal workers	β_f	0.54
Bargaining power of informal workers	β_i	0.46
Maximum of the distribution of G	ε_{max}^{G}	1
Maximum of the distribution of H_f	$\varepsilon_{max}^{H_f}$	1
Maximum of the distribution of H_i	$\varepsilon_{max}^{H_i}$	1
Arrival rate of informal monitoring shocks (being caught while informal)	ϕ	0.0017
Arrival rate of UB termination shocks	ρ	0.2
Arrival rate of UB qualification shocks	φ	0.08
General government tax	τ_g	0.32
SS value of agg productivity	p	1
Flow value of being unemployed (excluding UB)	z	0.5
Cost of opening a formal job	c	4/30
Endogenous Parameters		
Cost of posting a vacancy	k	0.42
Scaling parameter in the matching function	μ	0.15
Arrival rate of new productivity level for formal matches	λ_f	0.1
Arrival rate of new productivity level for informal matches	λ_i	0.3
Search efficiency while on the job	χ	0.2
Minimum of the distribution of G	ε_{min}^{G}	0.49
Minimum of the distribution of H_f	$\varepsilon_{min}^{H_f}$	-1.01
Minimum of the distribution of H_i	$\varepsilon_{min}^{H_i}$	-0.96
Penalty for being caught as informal firm	σ	84.36
Firing cost	F	4.02

Table 2: Steady State Equilibrium for Baseline Calibration

	No UB	With UB										
		Replacement rate = 0.3			Replacement rate = 0.5				Replacement rate = 0.7			
	Baseline	τ_b 2.0%	τ_b 4.0%	τ_b 8.3%	τ_b 2.0%	τ_b 4.0%	τ_b 8.3%	τ_b 16.7%	τ_b 2.0%	τ_b 4.0%	τ_b 8.3%	τ_b 26.5%
Unemployment	4.0%	4.2%	4.0%	3.6%	4.7%	4.4%	3.8%	2.9%	5.3%	5.1%	4.5%	1.8%
Vacancies	0.23	0.24	0.24	0.23	25.8%	25.4%	24.6%	23.2%	28.1%	27.7%	26.8%	23.0%
Employment	96.0%	95.8%	96.0%	96.4%	95.3%	95.6%	96.2%	97.1%	94.7%	94.9%	95.5%	98.2%
Formality	57.3%	53.9%	51.5%	45.1%	58.8%	57.5%	54.3%	46.0%	60.6%	60.0%	58.7%	48.6%
U-F flow rate	7.0%	9.0%	8.4%	7.0%	12.2%	11.8%	10.8%	8.5%	13.3%	13.3%	13.1%	9.9%
U-I flow rate	8.4%	6.6%	7.2%	8.5%	3.9%	4.2%	5.1%	7.1%	3.3%	3.3%	3.3%	6.0%
F-U flow rate	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.5%	0.4%	0.7%	0.6%	0.6%	0.3%
I-U flow rate	0.8%	0.9%	0.8%	0.7%	1.1%	1.0%	0.8%	0.5%	1.4%	1.3%	1.1%	0.3%
F-I flow rate	4.4%	6.5%	6.8%	7.4%	6.5%	6.7%	7.2%	8.4%	6.6%	6.7%	7.0%	8.7%
I-F flow rate	4.9%	6.4%	6.1%	5.2%	8.0%	7.9%	7.4%	6.2%	9.2%	9.1%	9.0%	7.4%
$\tilde{w}_i/\tilde{w}_f$	83.1%	78.3%	78.7%	79.8%	83.4%	83.8%	84.9%	87.5%	94.3%	95.1%	96.8%	104.7%
New u UB qualified		32.9%	32.9%	32.1%	22.0%	22.0%	21.6%	18.9%	13.0%	12.7%	12.0%	3.3%
Workers collecting UB		28.4%	26.2%	21.1%	39.6%	38.0%	34.4%	26.4%	47.5%	46.8%	45.2%	33.2%
UB Rev/UB Exp		25.0%	50.0%	100.0%	13.0%	26.0%	52.5%	100.0%	8.3%	16.6%	33.9%	100.0%

Notes: The description of the variables in the tables are as follows: "unemployment" is the aggregate unemployment rate; "vacancies" are the number of vacancies posted by firms; "employment" is the employment rate; "formality" is the ratio of formal to informal employment; $\tilde{w}_i/\tilde{w}_f$ is the average wage in the informal sector relative to that in the formal sector; "new u UB qualified" is the fraction of workers entering unemployment who have qualified to collect UB; "workers collecting UB" is the fraction of workers who collect UB out of the total number of unemployed and informal workers (who is the population of workers who could potentially collect UB); and "UB Rev/UB Exp" is the ratio of UB collections relative to the total expenditures for the government in UB payments, and represents the rate of self-financing of the UB program. The replacement rate is the fraction of the average formal wage, which is paid by the government as the UB, b.

Table 3: Steady State Equilibrium with Lower Firing Costs

	No UB	No UB	With UB										
			Replacement rate = 0.3			Replacement rate = 0.5				Replacement rate = 0.7			
	Baseline	F	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b
		3.61	2.0%	4.0%	8.3%	2.0%	4.0%	8.3%	16.7%	2.0%	4.0%	8.3%	26.5%
Unemployment	4.0%	4.1%	4.3%	4.1%	3.6%	4.9%	4.6%	4.0%	2.9%	5.5%	5.3%	4.8%	2.0%
Vacancies	23.2%	23.6%	24.7%	24.3%	23.6%	26.6%	26.2%	25.4%	23.8%	29.1%	28.7%	27.9%	24.0%
Employment	96.0%	95.9%	95.7%	95.9%	96.4%	95.1%	95.4%	96.0%	97.1%	94.5%	94.7%	95.2%	98.0%
Formality	57.3%	61.2%	56.4%	54.5%	50.0%	60.2%	59.5%	57.1%	51.4%	60.8%	60.4%	59.5%	54.5%
U-F flow rate	7.0%	8.4%	10.2%	9.7%	8.6%	13.1%	13.0%	12.2%	10.4%	13.5%	13.4%	13.3%	11.9%
U-I flow rate	8.4%	7.1%	5.5%	6.0%	7.1%	3.2%	3.2%	3.9%	5.5%	3.3%	3.3%	3.3%	4.3%
F-U flow rate	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.5%	0.4%	0.7%	0.7%	0.6%	0.3%
I-U flow rate	0.8%	0.9%	0.9%	0.9%	0.7%	1.2%	1.1%	0.9%	0.5%	1.4%	1.3%	1.2%	0.3%
F-I flow rate	4.4%	4.6%	6.8%	7.0%	7.6%	6.8%	7.0%	7.4%	8.3%	7.2%	7.3%	7.5%	8.4%
I-F flow rate	4.9%	5.9%	7.1%	6.9%	6.2%	8.5%	8.4%	8.2%	7.4%	9.7%	9.7%	9.6%	8.8%
$\tilde{w}_i/\tilde{w}_f$	83.1%	80.4%	78.3%	78.7%	79.7%	84.6%	85.1%	86.2%	88.8%	95.8%	96.8%	98.9%	108.5%
New u UB qualified			29.9%	30.1%	29.9%	19.3%	19.4%	19.2%	17.6%	10.7%	10.3%	9.5%	1.8%
Workers collecting UB			32.4%	30.5%	26.3%	43.2%	42.3%	39.3%	32.9%	49.4%	48.9%	47.8%	41.9%
UB Rev/UB Exp			24.0%	48.2%	97.1%	12.5%	25.2%	51.2%	98.5%	8.0%	16.2%	33.0%	99.4%

Notes: Low firing costs implies a cut in these costs by half, from $F = 4.02$ in the baseline calibration to $F = 3.61$. All other parameters remain the same. The description of the variables in the tables are as follows: "unemployment" is the aggregate unemployment rate; "vacancies" are the number of vacancies posted by firms; "employment" is the employment rate; "formality" is the ratio of formal to informal employment; $\tilde{w}_i/\tilde{w}_f$ is the average wage in the informal sector relative to that in the formal sector; "new u UB qualified" is the fraction of workers entering unemployment who have qualified to collect UB; "workers collecting UB" is the fraction of workers who collect UB out of the total number of unemployed and informal workers (who are the population of workers who could potentially collect UB); and "UB Rev/UB Exp" is the ratio of UB collections relative to the total expenditures for the government in UB payments, and represents the rate of self-financing of the UB program. The replacement rate is the fraction of the average formal wage, which is paid by the government as the UB, b.

Table 4: Steady State Equilibrium with Lower General Taxes

	No UB	No UB	With UB										
			Replacement rate = 0.3			Replacement rate = 0.5				Replacement rate = 0.7			
	Baseline	τ_g	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b
		28.8%	2.0%	4.0%	8.3%	2.0%	4.0%	8.3%	16.7%	2.0%	4.0%	8.3%	26.5%
Unemployment	4.0%	4.3%	4.5%	4.3%	3.9%	5.1%	4.8%	4.3%	3.2%	5.7%	5.5%	5.0%	2.2%
Vacancies	0.23	0.24	0.25	0.24	0.24	0.26	0.26	0.25	0.24	0.29	0.28	0.27	0.24
Employment	96.0%	95.7%	95.5%	95.7%	96.1%	94.9%	95.2%	95.7%	96.8%	94.3%	94.5%	95.0%	97.8%
Formality	57.3%	66.0%	57.2%	55.2%	50.1%	60.8%	59.5%	56.7%	49.6%	61.4%	60.9%	59.7%	51.3%
U-F flow rate	7.0%	8.7%	9.9%	9.3%	8.1%	12.8%	12.4%	11.5%	9.5%	13.4%	13.3%	13.2%	10.9%
U-I flow rate	8.4%	6.8%	5.8%	6.3%	7.5%	3.3%	3.7%	4.5%	6.3%	3.3%	3.3%	3.3%	5.1%
F-U flow rate	0.5%	0.6%	0.5%	0.5%	0.5%	0.6%	0.6%	0.5%	0.4%	0.7%	0.7%	0.6%	0.3%
I-U flow rate	0.8%	1.0%	1.0%	0.9%	0.8%	1.2%	1.1%	0.9%	0.6%	1.5%	1.4%	1.2%	0.4%
F-I flow rate	4.4%	3.7%	6.1%	6.4%	6.9%	6.2%	6.4%	6.9%	7.9%	6.5%	6.6%	6.8%	8.2%
I-F flow rate	4.9%	6.1%	6.9%	6.6%	5.9%	8.2%	8.1%	7.8%	6.8%	9.3%	9.3%	9.1%	7.9%
$\tilde{w}_i/\tilde{w}_f$	83.1%	81.1%	77.7%	78.1%	79.0%	82.8%	83.2%	84.1%	86.4%	93.0%	93.8%	95.5%	103.2%
New u UB qualified			32.5%	32.8%	32.8%	21.9%	22.0%	21.9%	20.4%	13.3%	13.1%	12.6%	6.2%
Workers collecting UB			31.5%	29.5%	25.0%	42.2%	40.6%	37.1%	29.7%	48.6%	47.9%	46.4%	36.2%
UB Rev/UB Exp			25.5%	51.0%	102.6%	13.1%	26.4%	53.4%	102.2%	8.4%	16.8%	34.3%	101.8%

Notes: Low τ_g implies a cut in the general government tax rate from $\tau_g = 32\%$ in the baseline calibration to $\tau_g = 28.8\%$. All other parameters remain the same. The description of the variables in the tables are as follows: "unemployment" is the aggregate unemployment rate; "vacancies" are the number of vacancies posted by firms; "employment" is the employment rate; "formality" is the ratio of formal to informal employment; $\tilde{w}_i/\tilde{w}_f$ is the average wage in the informal sector relative to that in the formal sector; "new u UB qualified" is the fraction of workers entering unemployment who have qualified to collect UB; "workers collecting UB" is the fraction of workers who collect UB out of the total number of unemployed and informal workers (who are the population of workers who could potentially collect UB); "UB Rev/UB Exp" is the ratio of UB collections relative to the total expenditures for the government in UB payments, and represents the rate of self-financing of the UB program. The replacement rate is the fraction of the average formal wage, which is paid by the government as the UB, b.

Table 5: Steady State Equilibrium with Higher Monitoring

	No UB	No UB	With UB										
			Replacement rate = 0.3			Replacement rate = 0.5				Replacement rate = 0.7			
	Baseline	ϕ	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b	τ_b
		0.0018	2.0%	4.0%	8.3%	2.0%	4.0%	8.3%	16.7%	2.0%	4.0%	8.3%	26.5%
Unemployment	4.0%	5.6%	5.9%	5.7%	5.5%	6.2%	6.0%	5.6%	4.9%	6.7%	6.5%	6.1%	3.8%
Vacancies	0.03	0.03	0.04	0.04	0.04	0.06	0.06	0.06	0.05	0.07	0.07	0.07	0.07
Employment	96.0%	94.4%	94.1%	94.3%	94.5%	93.8%	94.0%	94.4%	95.1%	93.3%	93.5%	93.9%	96.2%
Formality	57.3%	66.4%	57.6%	55.6%	50.5%	61.3%	60.1%	57.4%	50.6%	61.6%	61.1%	60.0%	53.0%
U-F flow rate	7.0%	8.5%	9.8%	9.3%	8.1%	12.8%	12.4%	11.6%	9.8%	13.2%	13.1%	13.0%	11.8%
U-I flow rate	8.4%	6.8%	5.7%	6.1%	7.2%	3.1%	3.4%	4.1%	5.8%	3.3%	3.3%	3.2%	4.0%
F-U flow rate	0.5%	0.7%	0.7%	0.7%	0.6%	0.7%	0.7%	0.7%	0.6%	0.8%	0.8%	0.7%	0.5%
I-U flow rate	0.8%	1.4%	1.4%	1.3%	1.2%	1.6%	1.5%	1.3%	1.0%	1.8%	1.7%	1.6%	0.8%
F-I flow rate	4.4%	3.5%	5.8%	6.1%	6.6%	5.9%	6.1%	6.5%	7.5%	6.2%	6.3%	6.5%	7.6%
I-F flow rate	4.9%	6.0%	6.9%	6.6%	5.9%	8.2%	8.1%	7.8%	6.9%	9.4%	9.3%	9.2%	8.1%
$\tilde{w}_i/\tilde{w}_f$	83.1%	83.0%	79.0%	79.3%	80.3%	84.5%	84.9%	85.8%	88.3%	95.3%	96.1%	98.1%	106.6%
New u UB qualified	17.4%	62.8%	34.3%	34.2%	33.4%	23.2%	23.1%	22.6%	19.9%	13.9%	13.5%	12.7%	5.4%
Workers collecting UB			32.0%	30.0%	25.3%	43.0%	41.5%	38.1%	30.8%	49.0%	48.4%	47.2%	38.6%
UB Rev/UB Exp			25.6%	51.2%	102.8%	13.2%	26.4%	53.5%	102.2%	8.3%	16.8%	34.2%	102.0%

Notes: In this experiment we increase the monitoring rate increase by 5 percent ϕ compared to the baseline case. The new value of ϕ is 0.0018. All other parameters remain the same. The description of the variables in the tables are as follows: "unemployment" is the aggregate unemployment rate; "vacancies" are the number of vacancies posted by firms; "employment" is the employment rate; "formality" is the ratio of formal to informal employment; $\tilde{w}_i/\tilde{w}_f$ is the average wage in the informal sector relative to that in the formal sector; "new u UB qualified" is the fraction of workers entering unemployment who have qualified to collect UB; "workers collecting UB" is the fraction of workers who collect UB out of the total number of unemployed and informal workers (who is the population of workers who could potentially collect UB); "UB Rev/UB Exp" is the ratio of UB collections relative to the total expenditures for the government in UB payments, and represents the rate of self-financing of the UB program. The replacement rate is the fraction of the average formal wage which is paid by the government as the UB, b.