

**On the relationship between labor market policies and outcomes in Bolivia:  
A search and matching approach\***

**Resultados en el mercado de trabajo y políticas laborales en Bolivia:  
un enfoque de búsqueda y emparejamiento**

(An Author's Accepted Manuscript; accepted on 02 February 2019, published in *Estudios Economía* 46(1) June 2019. [Link.](#))

Ricardo Nogales†

Pamela Córdova‡

Manuel Urquidí§

**Abstract**

In this paper we assess the relationship between labor policies and market outcomes in Bolivia, accounting for a large informal sector mostly comprised of self-employed entrepreneurs. We calibrate a job search and matching model to reproduce labor market features in 2013, a period in which important labor policy changes were simultaneously active for the first time. We focus on some effects of three specific policies namely a 14<sup>th</sup> salary, minimum wage increases and contributions to a 'solidary pension fund' on the sorting of workers between unemployment, formal and informal employment, as well as on the formal wage schedule.

Key words: *Labor markets, matching models, informality, labor policies.*

JEL Classification: *J08, J38, J46.*

**Resumen**

En este documento analizamos la relación entre algunas políticas laborales y resultados del mercado laboral en Bolivia, prestando atención particular a la existencia de un amplio sector informal. Calibramos un modelo de búsqueda y emparejamiento para reproducir las características del mercado en 2013, periodo en el que tres recientes políticas laborales estuvieron vigentes simultáneamente por primera vez. Analizamos algunos de los efectos en el desempleo, la informalidad en el mercado y la distribución de salarios en el sector formal generados por el "Doble Aguinaldo", el incremento del salario mínimo y las contribuciones obligatorias al "Fondo Solidario".

Palabras clave: *Mercados de trabajo, modelos de emparejamiento, informalidad, políticas laborales.*

Clasificación JEL: *J08, J38, J46.*

\* We are very grateful to Brisa Rejas, Carlos Foronda and Horacio Valencia for their suggestions and insights on previous versions of this document. We are also grateful to two anonymous referees and especially to Dr. Rómulo Chumacero for their comments and observations, which helped us improve the document substantially. The usual disclaimer applies.

† (Corresponding author) Centro de Investigaciones Económicas y Empresariales, Universidad Privada Boliviana. [rnogales@upb.edu](mailto:rnogales@upb.edu)

‡ Centro de Investigaciones Económicas y Empresariales, Universidad Privada Boliviana. [pcordova@upb.edu](mailto:pcordova@upb.edu)

§ División de Mercados Laborales y Seguridad Social, Banco Interamericano de Desarrollo. [manuelu@iadb.org](mailto:manuelu@iadb.org)

## **1. Introduction**

The labor market in Bolivia has been extensively analyzed from different perspectives (Andersen & Muriel, 2007; Mercado et al., 2003; Muriel, 2014; Román, 2011). Understanding the mechanisms of this market is interesting in its own right, but it has a particular importance because these mechanisms depict channels through which public policies and macroeconomic conditions are passed on to people's livelihoods. In recent years, important policy changes have taken place in the quest of increased protection for workers by promoting indefinite contracts, penalizing dismissal, reducing redundancy, setting minimum wages and establishing greater contributions to short-term and long-term social security, among others.

Interestingly, the existing rigorous academic literature on the effects of these policies on labor market outcomes in the country is relatively scarce, with Muriel (2014) being a notable exception to the best of our knowledge. We argue that understanding the effects of these policies is important because the natural demographic process has promoted a stable increase of the population of working age, and yet the dynamics of demand for workers in the formal sector have not proven capable to keep pace (Román, 2011). As a result, Bolivia is widely known for having one of the largest informal sectors in Latin America (Heckman & Pagés, 2004; ILO, 2013). Taking lack of access to the long-term social security system as the definition of an informal worker, the average informality rate in 2013-2015 was 82%. According to Román (2011), one plausible reason for such a sizable informal sector is that, while aiming at creating better conditions for workers, many labor policies also imply heavy direct costs for employers. In this sense, the size of

the informal sector could be the result of attempts to avoid (some of) the increasing labor costs, which ends up depriving a considerable part of the workforce of at least some of the benefits and legal rights that come along with a formal labor contract.

Under these circumstances, analyzing the configuration of the labor market in Bolivia and its relation to labor policies is not a straightforward issue; traditional indicators such as unemployment and participation rates depict incomplete figures that tend to blur the assessment of market efficiency and workers' welfare, as well as the effects of labor policies. We make the case that when analyzing the configuration of the labor market in Bolivia, informality has to be taken into account with particular attention. One may not rely on dual labor market theories, in which the informal sector is conceived as a parallel or excluded segment of the labor market. As stressed in Albrecht et al. (2009), Maloney (2004) and Gong et al. (2004), informal sectors of labor markets in Latin America may be interpreted as micro-entrepreneurial and self-employment sectors, in which labor costs are sought to be avoided and labor policies do not generate direct effects, rather than merely inferior or disadvantaged residuals of the formal sectors. In fact, according to Andersen & Muriel (2007), working in the informal sector may actually be, to some extent, the reflection of individual or household preferences in Bolivia. Following a similar line of reasoning, Muriel (2014) argues that medium-sized and large manufacturing firms in Bolivia may knowingly rely on short term labor contracts in order to be better prepared to face eventual economic downturns.

We defend the idea that the informal sector is an important source of income for many households in the country and thus it has a crucial social relevance. However, there is also vast empirical evidence supporting a negative relation between aggregate

productivity or aggregate output and the size of the informal sector (see e.g. Leal-Ordóñez, 2014), as well as aggregate education levels and the size of the informal sector (see e.g. Masatlioglu & Rigolini, 2008). These stylized facts combined with deprivation of at least some labor benefits support the general perception of informal jobs as low quality positions.

We argue that this complex context calls for a thorough analysis of the relation between labor policies and the job market configuration in the country, in the quest for effective policymaking towards improvement of employment conditions. In this paper, we intend to make a contribution to this matter, investigating the effects of recent labor policies on the sorting of workers between unemployment and the formal and informal sectors. Furthermore, we assess their effect on formal wages and on wage inequality within the formal sector. We take 2013 as our analytical reference point because it is a period in time when three recent labor policies were simultaneously active for the first time. These three policies are the focus our study: first, a 14<sup>th</sup> salary conditional on a yearly economic growth above 4.5%; second, the nominal 20% increase of the minimum wage, and third, compulsory contributions by employers amounting to 3% of the formal payroll to a pension fund called ‘Fondo Solidario’, in benefit of the least favored workers in terms of their opportunities for adequate retirement conditions.

Our strategy consists of applying a job search and matching model in an economy with a large informal sector proposed by Albrecht et al. (2009), which is in turn an extension of job market frictions analyses conducted by Diamond (1982) and Mortensen & Pissarides (1994). In this model, the informal sector is treated as an important part of the labor market where contracts and self-employment decisions are not framed within rules

established by public policies that are designed to directly affect formal labor contracts. Thus in order to focus on the direct effects of these policies, we do not take into account potential positive spill-overs of these policies on the informal sector<sup>1</sup>. Furthermore, in this framework, time use tradeoffs between labor and leisure from workers' viewpoint as well as capital investment decisions made by employers are considered exogenous (see Albretch et al., 2009). Hence, it is beyond the scope of this study to provide complete evaluations of the considered labor policies. Rather, we believe that our main contribution is to generate objective empirical evidence about some effects of these policies on the configuration of the labor market in Bolivia, while accounting explicitly for a large informal sector.

We pay particular attention to arrive at an appropriate calibration of this analytical framework for it to be useful for policy purposes. For this, we draw inspiration from similar versions of this model that have been used for assessing the role of public policies on the configuration of labor markets in Colombia (Albretch et al., 2017), Brazil and Mexico (Bosch & Esteban-Pretel, 2012) and Chile (Castex & Ricaurte, 2011). Although we focus on the effects of these policies in 2013, we performed a robustness check by calibrating our model for 2015, the last period in time in which the three considered policies were simultaneously active. Only after verifying the robustness of our model, we assess the effects of the policies of interest on the configuration of the labor market through simulations of counterfactual scenarios.

<sup>1</sup> One such effect may be, for instance, the expansion of the informal wage schedule induced by minimum wage increases, a situation termed 'the lighthouse effect' by Souza & Baltar (1979) and for which, Urquidi & Valencia (forthcoming as an IDB technical note) find evidence in Bolivia in 2006-2013.

Amongst our most salient results, we find that the three policies combined may have ended up increasing the part of permanent informal workers by 6 percentage points, with the 14<sup>th</sup> salary exerting the strongest effect, followed by minimum wage increases and finally contributions to “Fondo Solidario”. Furthermore, the three policies combined may have increased unemployment by 0.3 percentage points for workers situated at the highest end of the productivity schedule. Finally, although these policies reduce the dispersion of wages within the formal sector, this occurs around lower mean wage levels.

The document is structured as follows: Section 2 presents a brief overview of the labor market in Bolivia, including its configuration and current labor policies. Section 3 presents the essential characteristics and mechanisms of our job search and matching model, as well as the calibration of its parameters. Section 4 is the crux of document, as it presents counterfactual analyses to discuss the effects of the three labor policies that are the focus of this study. Finally, Section 5 presents our main concluding remarks.

## **2. A brief overview of the labor market in Bolivia**

Historically, Bolivia has enjoyed relatively low rates of unemployment. As shown in Figure 1, the mean annual unemployment rate in 2000-2013 is 6.3%, which is lower than the average of South America in the same timespan (9.3%).

[Figure 1 Here]

This rate shows a persistently decreasing trend of -0.4 points per year in 2000-2013. As depicted in Figure 2, unemployment rates in Bolivia have consistently lied below 5% in 2008-2013, getting as low as 3.2% in 2012, the lowest unemployment rate in the region according to ECLAC. This goes on to show that even if the potential workforce is steadily

increasing by effects of natural demographics, finding a source of income from work has been relatively easy in Bolivia during the last years compared to most other countries in the region.

[Figure 2 Here]

It is clear, however, that without a thorough assessment of conditions of employment, low unemployment rates alone do not allow to deduce gains of efficiency in the labor market. According to the 2013 Household Survey, most of the Bolivian workforce is employed under informal conditions in the sense that they are not affiliated with the pension funds (74%).

The lack of long-term social protection is usually combined with deprivation of other social security rights, such as dismissal compensations or access to health insurance, which has often led to perceive informal jobs as less advantaged working positions. Indeed, there is vast empirical support for a negative association between informality and productivity at the aggregate level (see e.g. Chong et al., 2007 for the case of Peru, and Busso et al., 2012 for the case of Mexico) and the individual level (see e.g. Hendy & Saki, 2013 for an analysis of MENA countries, and Bigsten et al., 2000 for the case of Kenya). Thus informality may be considered as a working condition for people with fewer realistic chances to be competitive in the formal sector due, in part, to low levels of skills and qualifications. According to Tornarolli et al., (2014), this statement seems particularly accurate to describe the case of countries in Latin America and the Caribbean. Based on a cross-country analysis, they stress that around 90% of the unskilled self-employed workforce in Brazil, Costa Rica, Colombia, El Salvador, Nicaragua, Peru and Bolivia are deprived of social protection linked to employment.

The causes of such a high level of informality in Bolivia are complex and their precise identification is beyond the scope of this study. However, Román (2011) argues that the possibility to avoid costs associated with the creation of formal position may be one of the main drivers of such a clear predominance of the informal sector in the economic activity. Indeed, this may be a suitable explanation, as according to the 2013 Household Survey, nearly all the self-employed workforce (60%) was informal in the sense that they did not enjoy coverage in the long-run social security system. Furthermore, ‘tiny’ businesses (i.e. firms owned by only one person) have been the most prominent firm type for a long time in the country. As shown in Figure 3, more than 200 000 tiny businesses are officially operating, which accounts for 80% of the Bolivian firms, a stable figure in 2013-2015. We believe that these facts provide further support for Román’s statement, as legal requirements for the establishment of these tiny firms are the least restrictive in terms of fees and time, and they are also the only type of firms recognized by law that may not have registration as formal employers in the Ministry of Labor.

[Figure 3 Here]

Indeed, there seems to be important gains of setting up this type of very small business instead of starting a larger one. According to the World Bank (2015), starting a larger-scaled business in the country requires undertaking 15 procedures that last 49 days long and represent costs equivalent to 65% of the average annual income per capita (i.e. 2’000 current USD); all these costs are well above the average of the region.

At this point, it is important to have a clear idea about the magnitude of the labor costs that some agents in the labor market seek to avoid through informality. In order to set solid grounds for an adequate calibration of our analytical framework, here we limit ourselves to present the essential aspects of these laws that are related to costs for formal

employers. Charges to employers include: compulsory contributions to the national health system (10% of the salary) and to a national program for subsidized housing (2% of the salary); an insurance prime against personal risks at the working post (1.71% of the salary); a compensation upon removal from post equivalent to one monthly salary for each year at work; a compensation in case of unfair dismissal equivalent to three monthly salaries, and finally, a 13<sup>th</sup> salary every year. These formal benefits depict an increase of 30.37% of the yearly salary paid by employers.

Today, labor regulations offer an important set of benefits to workers who enjoy indefinite contracts, including a lower bound to the monthly salary and monetary and non-monetary benefits to female workers with newborn children. In this study we focus on three recent benefits for workers that have created additional labor costs for the employers:

- The *first* benefit is related to compulsory contributions to a pension fund called ‘Fondo Solidario’ that aim at helping the least favored workers in terms of their chances for adequate retirement conditions. It is created in the Pension Law of 2010 and sets a contribution by employers amounting to 3% of the payroll.
- The *second* is a yearly minimum wage increase. In 2013, this floor wage was nominally increased by 20% reaching 173.42 USD per month. In our framework, we associate minimum wage increases to payroll taxes because any revision of these floor wage affects all formal labor contracts in the country through a scale of compulsory seniority bonuses that are indexed to minimum wage, which vary according to tenure.
- The *third* benefit is the payment of a 14<sup>th</sup> salary conditional on an annual economic growth above 4.5%. This benefit was created in Supreme Decree 1802 of 2013 and it was binding for three years in a row (2013-2015).

The facts that we briefly present here lead to perceive that there may be a close relation between labor policies and the configuration of the labor market. We go on to investigate this issue building on a theoretical framework that allows analyzing decisions taken, on the one hand, by the workers in terms of taking up an informal job as a source of income or compete for a formal position and, on the other hand, by formal employers in terms of keeping a worker in place or creating vacancies and choosing workers to fill them up. We posit that a job search and matching model similar to the one proposed by Albrecht et al. (2009), Diamond (1982) and Mortensen & Pissarides (1994) serves well for this purpose and it allows gauging the extent to which the labor policies that we describe here affect individual decisions.

### **3. The Job Search and Matching Model**

We describe here the essential technical aspects of a model in which the informal sector is conceived as an unregulated sector in the sense that it is not directly affected by labor policies. At the outset, let us stress that we focus on two *types* of labor policies. The first are policies that generate costs for the employer in case of dismissal; they represent severance taxes and will be denoted as  $s$ . In the Bolivian case, the only policy of this type is a compensation for unfair dismissal. The second type of policies generates costs for the employer while they are engaged in a formal labor contract; they represent payroll taxes and will be denoted as  $\tau$ .

In turn, we propose to divide these policies according to their effect on salaries. We reason that some of the current payroll taxes in Bolivia represent a direct increase in salaries for

formal workers, such as the 14<sup>th</sup> salary and minimum wage increases. In contrasting fashion, compulsory contributions to ‘Fondo Solidario’ represent a payroll tax without direct benefits to workers in terms of current monetary compensations. Taking into account the difference between these two types of payroll taxes is important because it determines whether or not there is a direct effect on cash-flow received by workers.

### **3.1. The informal sector**

Based on our previous discussion, we associate the informal sector with low levels of productivity and thus, low levels of income flows for workers. In this sector, job opportunities and job destructions arrive at exogenous Poisson rates denoted as  $\alpha$  and  $\delta$ , respectively. A job in this sector generates a constant exogenous flow of income denoted as  $y_0$ . The reason for treating this sector with such simplicity is that the dynamics of creation and destruction of informal jobs cannot be represented through a competitive process of job-matching governed by optimizing behavior of firms and potential workers as it is proposed in mainstream labor economics theory. We argue that this is particularly true in the Bolivian case due to the predominance of self-employment in the informal sector.

### **3.2. The formal sector and the productivity process**

The dynamics in the formal sector of the job market are more complex as the arrival of job opportunities and the job destruction process are endogenous. Let us focus first on the arrival rate of job opportunities, given by the matching function. We draw inspiration from Pentrongolo & Pissarides (2011) to propose a Cobb-Douglas form for the latter:

$M(U, V) = AV^\beta U^{1-\beta}$  where  $V$  denotes the number of vacancies in this sector,  $U$  denotes the stock of unemployed workers,  $\beta$  denotes the elasticity of the number of job matches with respect to the number of vacancies and  $A$  denotes the level of technology. The latter parameter is related to the efficiency of the matching process in the labor market: greater values of  $A$  depict better opportunities for an unemployed worker to find a formal job. In our setting, an unemployed worker finds a job in one-year time with probability  $\frac{M(U,V)}{U} \equiv m(\theta) = A\theta^\beta$ , where  $\theta \equiv \frac{V}{U}$  denotes the market tightness. From the workers' perspective, lower values of  $\theta$  depict greater difficulties to find a formal job. From the formal employer's perspective, lower values of  $\theta$  depict greater choices to fill up a vacancy.

The job destruction process is linked to the productivity process, so let us first present the main elements describing the workers' productivity schedule. For notational simplicity, we will describe the case of a representative worker omitting the individual index. Let us denote the level of productivity of this worker by  $y$ ; workers are heterogeneous in that each of them possesses a different maximum or potential level of productivity, denoted as  $\bar{y}$  for the representative worker. When a firm meets with this worker,  $\bar{y}$  cannot be known with certainty, thus we assume that  $\bar{y}$  may take values that are *iid* draws from a standard uniform distribution, i.e.  $prob[y = \bar{y}] \equiv f(\bar{y}) = 1, \forall \bar{y} \in (0,1)$  and  $prob[y \leq \bar{y}] \equiv F(\bar{y}) = \bar{y}, \forall \bar{y} \in (0,1)$ .

At the beginning of a match, the worker performs at their potential level of productivity,  $\bar{y}$ . Later on, productivity shocks may negatively affect the worker's performance, threatening the stability of the match. These productivity shocks arrive at an exogenous Poisson rate  $\lambda$  and they may account for a wide array of situations including demotivation, obsolescence of skills, family/personal conflicts, etc. From the firms'

perspective, there is a minimum level of productivity required to maintain a worker in place, which is called the reservation productivity and denoted as  $R(\bar{y})$ . If a shock diminishes the worker's productivity below  $R(\bar{y})$ , then the job is destroyed; if the shock is not 'strong enough', the productivity diminishes to a new level  $y' < \bar{y}$ , but the job is not destroyed.

The intensity of the productivity shocks cannot be known with certainty, but their conditional probability of occurrence can be deduced from the distribution of potential productivity levels. For any given potential level of potential productivity  $\bar{y} \in (0,1)$ , the probability of a shock resulting in a lower level of productivity  $y' < \bar{y}$  is given by:

$$\text{prob}\{y = y' | y' \leq \bar{y}\} = \frac{\text{prob}\{y = y'\}}{\text{prob}\{y \leq \bar{y}\}} = \frac{f(y')}{F(\bar{y})} = \frac{1}{\bar{y}} \quad \forall 0 \leq y' \leq \bar{y} \quad (1)$$

Wages in the formal sector, denoted as  $\omega$ , are associated to each workers' level of potential productivity  $\bar{y}$  and depend on whether or not a shock has taken place inducing a lower level of productivity  $y'$ , i.e.  $\omega = \omega(y', \bar{y})$ .

### 3.2.1. The search process: the workers' perspective

For a worker of potential productivity  $\bar{y}$ , there are three possible states: i) to be unemployed with an expected gain denoted as  $U(\bar{y})$ ; ii) to be in the informal sector with and expected gain denoted as  $N_0(\bar{y})$  and iii) to be in the formal sector with expected gain denoted as  $N_1(y', \bar{y})$ . Note that receiving the maximum wage is a particular case that occurs when  $y' = \bar{y}$ , i.e. no productivity shocks have taken place.

We consider that if a worker is unemployed, they have a nil income, as there are no public unemployment insurance or conditional transfers in this situation. At this state, the current-valued expected gain for the (potential) worker is given by:

$$rU(\bar{y}) = 0 + \alpha \max[N_0(\bar{y}) - U(\bar{y}), 0] + m(\theta) \max[N_1(y', \bar{y}) - U(\bar{y}), 0] \quad (2)$$

The first element in equation (2) represents the null gain of being unemployed. The second element represents the expected gain of leaving unemployment to occupy an informal post, and the third element represents the expected gain of leaving unemployment to occupy a formal post.

When a worker is employed in the formal sector, holding a post that offers all social security rights, their current-valued expected gain is:

$$\begin{aligned} rN_1(y', \bar{y}) &= \omega(y', \bar{y}) + \lambda \text{prob}\{y \leq R(\bar{y}) | y \leq \bar{y}\} (U(\bar{y}) - N_1(y', \bar{y})) \\ &\quad + \lambda \int_{R(\bar{y})}^{\bar{y}} (N_1(x, \bar{y}) - N_1(y', \bar{y})) \cdot \text{prob}\{y = x | y \leq \bar{y}\} dx \\ &= \omega(y', \bar{y}) + \lambda \frac{R(\bar{y})}{\bar{y}} (U(\bar{y}) - N_1(y', \bar{y})) \\ &\quad + \lambda \int_{R(\bar{y})}^{\bar{y}} (N_1(x, \bar{y}) - N_1(y', \bar{y})) \frac{1}{\bar{y}} dx \end{aligned} \quad (3)$$

The first element in the right-hand side of equation (3) represents the wage awarded to a worker of potential productivity  $\bar{y}$  performing at an actual level of productivity  $y' \leq \bar{y}$ . The second element represents the expected loss resulting from a match-dissolving shock of productivity that pushes the worker to unemployment. The third element

represents the expected loss resulting from a productivity-diminishing but not match-dissolving shock of productivity.

When a worker is employed in the informal sector, their current-valued expected gain is:

$$rN_0(\bar{y}) = y_0 + \delta(N_0(\bar{y}) - U(\bar{y})) \quad (4)$$

The first element in equation (4) represents the exogenous income offered by any post in the informal sector and the second element represents the expected loss of leaving the informal sector to become unemployed.

These equations make it clear that workers may transit between unemployment and the informal sector or between unemployment and the formal sector, but they may not directly transit between the informal and the formal sectors.

### **3.2.2. The search process: the firms' perspective**

From the perspective of a formal employer, there are two possible states. First, the post is occupied by a worker of potential productivity  $\bar{y}$  and performs at an actual productivity  $y'$ . Let us denote as  $J(y', \bar{y})$  the expected gain for the employer in this state. Second, the post is vacant giving an expected gain for the employer denoted as  $VV$ .

The current-valued expected gain in the first state is given by:

$$\begin{aligned}
rJ(y', \bar{y}) &= y' - \omega(y', \bar{y})(1 + \tau) + \lambda \text{prob}\{y \leq R(\bar{y}) | y \leq \bar{y}\} (VV - J(y', \bar{y}) - s) \\
&\quad + \lambda \int_{R(\bar{y})}^{\bar{y}} (J(x, \bar{y}) - J(y', \bar{y})) \cdot \text{prob}\{y = x | y \leq \bar{y}\} dx \\
&= y' - \omega(y', \bar{y})(1 + \tau) + \lambda \frac{R(\bar{y})}{\bar{y}} (VV - J(y', \bar{y}) - s) \\
&\quad + \lambda \int_{R(\bar{y})}^{\bar{y}} (J(x, \bar{y}) - J(y', \bar{y})) \cdot \frac{1}{\bar{y}} dx \tag{5}
\end{aligned}$$

The first element in equation (5) denotes the contribution of the worker to the employer's activity, which is depicted by the level of productivity at which they actually perform. The second element represents the cost of employing a worker that performs at a level of productivity  $y'$ , including all the payroll taxes established by labor regulations. The third element represents the expected loss of firing a worker after a match-dissolving shock of productivity, including severance taxes; and the third element represents the expected loss of a productivity-diminishing, but not match-dissolving shock of productivity.

In order to identify the current valued expected gain of a vacancy for the employer, let us recall that the number of potential matches for each vacant post can be written as:  $\frac{M(U,V)}{V} \equiv \frac{m(\theta)}{\theta}$ . This ratio depicts the rate at which job-filling opportunities arrive from the employer's perspective. Thus the current-valued expected gain of a vacancy,  $VV$ , is given by:

$$rVV = -c + \frac{m(\theta)}{\theta} E\{\max[J(y', \bar{y}), 0]\} \tag{6}$$

where  $c$  represents the cost of keeping a vacancy and the second element in the equation above represents the expected value of filling up a vacancy.

After briefly describing the basic setting of the model, it is important to notice that one key aspect of the framework proposed in Albrecht et al. (2009) is that the maximum level of productivity defines three types of workers that have very distinctive dynamics in the labor market:

- i) ‘Low productivity workers’ that are always bound to work in the informal sector, and thus we may refer to them as *permanent informal workers*. Maloney (2004) attributes this to the fact that there are levels of qualifications that are not sufficient for allowing a worker to perceive that they are competitive enough in the quest for a formal position and so, in expectation, they would be better off in the informal sector. Thus there is a productivity threshold, denoted as  $y^*$ , below which the expected gain of being employed in the formal sector is equivalent to the expected gain of being unemployed:

$$N_1(y', \bar{y}) = U(\bar{y}) \quad \text{if } \bar{y} \leq y^* \quad (7)$$

- ii) ‘High productivity workers’ that are never found in the informal sector. If these workers were unemployed, their level of productivity allows them to perceive that the opportunity-cost of leaving unemployment for obtaining an informal source of income is too high. We may refer to them as *permanent formal workers*. Thus there is a second productivity threshold denoted as  $y^{**}$ , above which the expected gain of occupying a formal post is always higher than the expected gain of being in the informal sector. This means that for a worker with a level of productivity  $y^{**}$ , the expected gain of being unemployed is identical to the expected gain of being in the informal sector:

$$N_0(\bar{y}) = U(\bar{y}) < N_1(y', \bar{y}) \quad \text{if } \bar{y} \geq y^{**} \quad (8)$$

- iii) ‘Medium productivity workers’ that may consider taking formal as well as informal positions depending on which opportunity comes along first. We may refer to them as *potential informal workers*. These workers have a level of productivity between  $y^*$  and  $y^{**}$ .

Thus in this framework, workers are divided in three groups according to the values of the aforementioned thresholds  $y^*$  and  $y^{**}$ , which are endogenous and may be influenced by labor policies.

### 3.3. The equilibrium and wage determination: a brief description

The fundamental steady state condition establishes that the expected value of a vacancy is null,  $VV = 0$ , because when this condition is met, there is a fixed number of vacancies offered by the employers (see Albrecht et al., 2009).

Of course, wages play a crucial role in labor market equilibrium and the fulfillment of the fundamental steady-state condition. Wages in the formal sector are determined through a Nash private bargaining process, in which the worker has an exogenous negotiating power denoted as  $\gamma$ , and that of the firm is denoted as  $1 - \gamma$ . The total gains of creating a formal job are calculated as the aggregate gains for the worker and for the firm, each weighted by their respective bargaining power.

For the identification of wage schedules compatible with equilibrium, we follow Albrecht et al. (2009) and stress that two different scenarios have to be considered: either i) the worker performs at maximum productivity, i.e. no shocks have occurred, or ii) the worker performs at a productivity level that is lower than their maximum potential. The main difference between the two scenarios is that in the event of a productivity shock, the firm may consider ending the job having to decide whether to avoid or face severance costs,  $s$ , established in Bolivian labor legislations. Thus in this setting, the firms' gains in the wage negotiation process depends on whether or not a productivity shock has taken place. Thus wages schedules at equilibrium are determined through a **private** negotiation process between the firm and the employer according to the following program:

$$\omega(y', \bar{y}) \text{ solves } \begin{cases} \max [N_1(y', \bar{y}) - U(\bar{y})]^\gamma J(y', \bar{y})^{1-\gamma} & \text{if } y' = \bar{y} \\ \max [N_1(y', \bar{y}) - U(\bar{y})]^\gamma [J(y', \bar{y}) + s]^{1-\gamma} & \text{if } y' < \bar{y} \end{cases} \quad (9)$$

At this point, we make the case that a modification to the model proposed by Albrecht et al. (2009) is required. As mentioned before, two of the labor policies that we analyze here, namely the 14<sup>th</sup> Salary and minimum wage increases, modify the cash-flow received by a formal worker. In a way, these policies represent a salary increases for formal workers obtained through an exogenous **collective** bargaining process promoted by public authorities. This bargaining process may not alter the optimization program above, as it affects all formal labor contracts equally. In presence of such policies, the formal wage schedule at equilibrium is modified *ex post factum* to  $\tilde{\omega}(y', \bar{y})$  as following:

$$\tilde{\omega}(y', \bar{y}) \equiv \omega(y', \bar{y}) \cdot (1 + \xi) \quad (10)$$

where  $\xi < \tau$  is the part of the payroll taxes charged to the firm,  $\tau$ , that increases cash-flows for workers.

### 3.4. Calibration

We calibrated the model to fit the main characteristics of the Bolivian urban labor market in 2013 and then we performed a similar exercise for 2015 to check for consistency (see Appendix 1). We take 2013 as the baseline case of our model because it is the first period in which the three labor policies that we study were simultaneously bidding. The baseline case is calibrated with a year as the time unit and we set values for the parameters as follows:

- The discount rate,  $r$ , is associated with the real interest rate, which is 4.8% according to the World Bank.
- In absence of longitudinal data required for the empirical estimation of a matching function for the urban Bolivian labor market, we follow standard results in the literature to set values for the parameters of this function (Albrecht et al., 2009, 2017):
  - o The elasticity of the number of matches per year with respect to the market tightness, denoted as  $\beta$ , and the bargaining power by workers, denoted as  $\gamma$ , are both set set to 0.5. Thus we assume that workers and employers in the formal sector have equal negotiation power in the wage determination process.
  - o We set  $A$  to 3. The median unemployment duration of urban workforce is 4 months in 2013, which in a stationary environment depicts a job-finding

rate of 0.25 each month, i.e. 3 each year. Considering that  $\beta$  is set to 0.5 and that a reasonable value of market tightness ranges from 0.8 to 1.25, then the matching technology coefficient should range between 2.683 and 3.354, which justifies our proposal of 3 for this parameter.

- The income flow of informal workers,  $y_0$ , is set to 0.43, depicting the ratio between the median income of workers without affiliation the pension fund and that of workers with affiliation to this fund.
- Assuming an exponential distribution for job destruction in the informal sector, the rate of occurrence of this event,  $\delta$ , can be represented as the inverse of the median duration of employment in the informal sector, which is around 4 years according to the 2013 Household Survey. Thus we set  $\delta = 0.25$ .
- The arrival rate of productivity shocks in the formal sector,  $\lambda$ , is set to 0.2. Assuming an exponential distribution for the arrival time of these shocks, this rate implies an expected duration of 5 years without experiencing a shock. According to the 2013 Household Survey, this value exactly corresponds to the median duration of employment in the formal sector.
- The rate of arrival of employment opportunities in the informal sector,  $\alpha$ , is set to 6 in order to replicate the unemployment rate of 4.02%.
- The cost of a vacancy for the firm,  $c$ , is set to 0.2. We aimed at replicating the fact that when the steady-state condition,  $VV = 0$ , is fulfilled,  $c$  represents the expected gain of a hiring a new worker in terms of productivity. This expectation is calculated as the ratio between the average wage of workers in 2013 and the GDP per capita.
- The severance tax,  $s$ , is set to 5%. We propose this value as an estimation of the due compensation in case of unfair dismissal. According to the current

regulations, the employer must pay the equivalent of three months of salary to the worker in case of dismissal. To face up to this cost, the employer is forced to make a monthly prevision of 5% of the payroll. This yields a yearly prevision fund of 60% of the payroll, which, by the end of the median duration of employment in the formal sector, i.e. 5 years, allows the employer to fully cover this severance cost.

- The payroll taxes coefficient,  $\tau$ , is set to 45.2% as it comprises the 13<sup>th</sup> salary (8.33%), the prime for insurance against professional risks at work (1.71%), the contribution the subsidized housing program (2%), the compensation for removal from post (8.33%), the contribution to the national health system (10%), the contribution to 'Fondo Solidario' (3%), the 14<sup>th</sup> salary (8.33%) and the minimum wage increase between 2012 and 2013, which we set to 3.5%. This latter figure is calculated considering the 2012 median formal urban worker, who received an annual salary of 3'813.80 USD and held a 5-year tenure entitling her to a seniority bonus equivalent to 11% of three minimum wages. By virtue of the minimum wage increase between 2012 and 2013, the median worker received an additional 132.76 USD/year, representing a 3.5% payroll increase.
- Coefficient  $\xi$  is set to 28.49% as it comprises payroll taxes in  $\tau$  that have a direct impact on the workers' salaries, namely the 13<sup>th</sup> and 14<sup>th</sup> salaries, minimum wage increases and compensations for removal from post.

#### **4. Results and Simulations**

Let us start this section by comparing actual data to model-generated statistics in order to show how well our proposed calibration manages to capture the state of affairs in 2013 (see Table 1).

[Table 1 Here]

In light of the figures presented at Table 1, we argue that our proposed calibration manages to closely replicate the sorting of workers between formality, informality and unemployment. Furthermore, the model does well in separating informal workers according to their productivity level (potential of permanent informal), which we associate to their education as proxy of skill stocks. We find a similarly good fit for 2015 data (see Appendix 1).

In order to gauge the effects of minimum wage increases, the 14<sup>th</sup> salary and contributions to “Fondo Solidario” on the labor market configuration, we construct three counterfactual scenarios that simulate the absence of each labor policy, one at a time. The results of these simulations are presented in Table 2.

Counterfactual scenario 1 is created to gauge the effect of minimum wage increases by comparing the baseline scenario (the real situation of the labor market in 2013) with a counterfactual situation where there are no minimum wage increases. In absence of this policy, payroll taxes  $\tau$  would reduce by 3.5 percentage points, while everything else is held constant.

Counterfactual scenario 2 depicts a situation in which neither the 14<sup>th</sup> salary nor minimum wage increases exist. In this case, payroll taxes  $\tau$  would drop an additional 8.33 percentage points compared to counterfactual scenario 1, representing a 11.83 percentage

points reduction of payroll taxes compared to the baseline scenario. By construction, comparing this scenario with counterfactual scenario 1 allows deducing the effect of the 14<sup>th</sup> salary.

Counterfactual scenario 3 is constructed to represent a situation in which none of the three analyzed policies exist. In absence of contributions to “Fondo Solidario”, payroll taxes would drop an additional 3.0 percentage points compared to counterfactual scenario 2, resulting in a total payroll tax reduction of 14.83 percentage points in absence of all three considered policies compared to the baseline scenario. By construction, comparing counterfactual scenario 3 to counterfactual scenario 2 allows deducing the effects of contributions to “Fondo Solidario”.

[Table 2 Here]

Our study yields three main results about the effect of the considered labor policies, which are found to be consistent in light of the robustness check with 2015 data (see Appendix, 1): i) they considerably increase the size of the informal sector, ii) they promote an increase of unemployment rates for workers at the higher end of the productivity schedule, and iii) they promote a reduction of the mean formal wage and increase the concentration of formal wages around this lower level.

#### *Effects on the sorting of workers between formality and informality*

According to the mechanisms of the model, informality increases due to higher costs for formal employers implied by the considered labor policies. These costs reduce the vacancy creation rate as they imply lower expected values of posting a vacancy. In this context, as formal posts became scarcer and employers become more demanding in terms

of a worker's contribution to the productive process, realistic chances of occupying a formal post become more exclusive to workers belonging to the higher end of the productivity schedule. Holding everything else constant, fewer vacancies reduce the number of matches generated in the formal sector, which makes workers turn to the informal sector for job opportunities.

For a deeper analysis of this issue, we make the distinction between the two types of informal workers that increase due to these policies: i) the permanent informal workers, with levels of productivity below the low-cut threshold  $y^*$ , and ii) the potential informal workers, with medium productivity lying between the cut off thresholds  $y^*$  and  $y^{**}$ . The effects are summarized in Table 3.

[Table 3 Here]

According to the 2013 Household Survey, the employed economically active population in urban areas included 3'182'187 people. In the baseline scenario, 60.45% (1'924'268) of this population were informal workers. We find that in absence of minimum wage increases, the part of permanent informal workers would drop by 1.44 percentage points (45'823). Similarly, this part would drop further by 3.41 points (109'513) and 1.22 points (38'823) in absence of the 14<sup>th</sup> salary and contributions to "Fondo Solidario". Thus the 14<sup>th</sup> salary is the policy that has contributed the most to the increase of permanent informal workers, followed by wage increases and contributions to "Fondo Solidario". This may be due to the fact that, even if it is a contingent policy, the 14<sup>th</sup> salary represents the highest monetary cost for the employers among all other considered policies. In absence of all the three policies, the part of permanent informal workers would be 6.07 percentage points lower regrouping 54.4% of the workforce (1'731'110), which is still a very high level of informality. Thus even if the increasing costs for the formal firms have

increased the attractiveness of the informal sector, the size of the latter is the result of structural characteristics of the Bolivian economy that transcend of labor policies, and thus lie outside the scope of this study.

Turning now to potential informal workers, we estimate that this type of workers represents 11.23% of the workforce (357'360) in the baseline scenario. According to our results, without minimum wage increases, the 14<sup>th</sup> salary, increases and contributions to “Fondo Solidario”, the part of potential informal workers would drop by 0.39 points (12'411), 0.94 points (29'913) and 0.21 points (6'683), respectively. We thus confirm that among the three considered policies, the 14<sup>th</sup> salary contributes the most to the expansion of the informal sector. These figures show that formal positions are not widely available even for workers with medium productivity; most of them are forced to resource to the informal sector in the quest for a monetary income. Furthermore, the high rate of potential informal workers that are actually informal may be the result of a willingly taken choice motivated by individual preferences, culture and tradition. Also, as stressed in Heckman & Pagés (2004) and Frolich et al. (2014), this behavior may be induced by a perception of low expected gains of becoming a formal worker and having access to short-term and long-term social security services, due, for example, to lack of trust in these institutions.

The effects of the considered policies on informality are coupled with a reconfiguration of the part of permanent formal workers. We estimate that the part of these workers represents 28.3% (900'559) in the baseline scenario. In absence of all the three labor policies, we find that this part would raise up to 35.91% (1'142'723). The difference of 7.61 percentage points can be divided in 1.83 points (58'234), 4.27 points (135'879) and

1.51 points (48'164) caused, respectively, by minimum wage increases, the 14<sup>th</sup> salary and contributions to “Fondo Solidario”. This constitutes further evidence for the fact that the 14<sup>th</sup> salary has contributed the most to the reduction of attractiveness of the formal sector compared to the informal sector, followed by wage increases and contributions to “Fondo Solidario”. Clearly, these policies have pushed highly productive workers back to the category of medium productivity workers, who end up in the informal sector due to the lack of opportunities in the formal sector and/or individual preference for informality.

#### *Effects on unemployment*

Our second main result is that the considered labor policies promote a slight increase of overall unemployment rates (see Table 2). However, highly productive workers suffer the largest drawback in terms of employment opportunities; the considered labor policies increase unemployment rates for this type of workers from 4.5% to 4.8%. It is also worth noticing that the considered policies promote an increase of unemployment rates for medium productive workers (from 2.28% to 2.41%). By construction, these policies do not change the unemployment rate of the least productive workers, as they are excluded from the formal sector.

Clearly, the considered policies have negative effects for workers situated at the higher end of the productivity schedule. These policies reduce the expected value of a hiring a worker in the formal sector, and thus reduce the number of formal vacancies per unemployed worker (note that  $\theta \equiv \frac{V}{U}$  drops from 1.52 to 1.37 when all three labor policies

are active). Furthermore, these policies considerably elevate the reservation productivity for formal posts (from 0.55 to 0.62), threatening the stability of existing formal jobs.

In line with these results, we estimate that the average duration of unemployment increases by 5.26% due to the considered policies (see Table 2). Once again, this negative effect is concentrated in the workforce situated at the higher end of the productivity schedule, as policies only affect the formal sector.

Workers with medium levels of productivity are also affected by these policies. We find that their chances of finding a formal job drops by 1.1 percentage points when all three policies are active. This means that these workers are forced to settle for an informal post, as unemployment is the only fallback option for them in presence of these policies.

According to the mechanisms of the model, all the results that we present here are the reflection of an overall loss of efficiency in the matching process due the considered policies. An indicator of this negative effect is the fact that the monthly rate of new formal labor relationships drops by 5.13% (see Table 2) due to these policies.

#### *Effects on formal wages*

Finally, our results show that formal wages drop due to these policies (see Table 2). In absence of the three policies, the mean formal wage would rise from 0.527 to 0.564, representing a 7% increase. This may be related to the fact that the reservation productivity rises when the labor policies are active, thus increasing the probability of formal workers to lose their posts should negative shocks occur. In our view, this result

allows to infer possible negative effects on aggregate wellbeing that lie beyond our model, as a reduction of real wages may be associated to a reduction of aggregate consumption and output. This is due to the fact that the considered policies promote a concentration of the workforce in less productive economic sectors.

Further to this, our results show that the considered policies reduce the dispersion of formal wages around lower mean levels. In absence of all three policies, the standard deviation of wages in the formal sector would raise from 0.065 to 0.086 (+32%). However, following our previous argument, we make the case that this reduction in equality within the formal sector needs to be interpreted through a cautious lens, as it takes place alongside a reduction of overall aggregate wellbeing and output.

## **5. Concluding Remarks**

The main purpose of this paper is to bridge the existing analytical gap about some effects of recent labor policies in Bolivia. In 2013, three new policies namely the 14th salary, a minimum wage increase and compulsory contributions to “Fondo Solidario”, were simultaneously active for the first time, rising costs for formal employers from 30.37 to 45.2% over payroll. The actual extent to which these policies have reconfigured labor market outcomes remains largely understudied, but building upon Albretch et al. (2009), Diamond (1982) and Pissarides & Mortensen (1994), we showed that a search and matching framework that accounts for the existence of a large informal sector may be a useful tool to generate evidence about some effects of these policies. From an analytical viewpoint, we presented a thorough analysis of their effects in 2013, but we also

performed a robustness check calibrating the model for 2015 data, finding that all the results for 2013 are consistent.

One of the main contributions of our paper lies on the possibility to make the difference between two types of workers in the informal sector: permanent and potential. The first are workers with low levels of productivity, which do not allow them to aspire to occupy formal jobs; the latter are workers with medium levels of productivity and may consider taking up informal jobs if they perceive that they are better off choosing this option over waiting for the arrival of chances to occupy a formal post.

Our main results can be divided in three groups of effects: i) those on the sorting of workers between the formal and the informal sectors, ii) those on unemployment and iii) those on the formal wage schedule:

- i) Both types of informal workers have considerably increased due to the three considered policies. We estimate that in 2013, 1.9 million people (60% of the workforce) were permanent informal workers; around 136'000 of these people were in this situation due to the 14th salary, 59'000 due to the minimum wage between 2012 and 2013 and 48'000 due to contributions to "Fondo Solidario". We also estimate that 0.36 million people (11% of the workforce) were potential informal workers of which 30'000 can be attributed to the 14th salary, 12'000 to minimum wage increases and 7'000 to contributions to "Fondo Solidario". Thus, the 14th Salary fosters the strongest reduction of the job-creation rate in the formal sector.
- ii) While increasing informality, these policies increase unemployment rates as well, particularly for workers at the highest end of the productivity schedule. Thus these

policies seem to be penalizing the most productive workforce in terms of their opportunities of acquiring a formal job.

- iii) These policies promote a reduction of mean formal wages due, partly, to higher reservation productivities. At the same time, these policies promote a concentration of formal wages around this lower level. We believe that this goes on to show that these policies may entail a reduction of aggregate wellbeing and output.

From a methodological viewpoint, wages in the informal sector are considered exogenous in our setting, as it is a sector mainly comprised by self-employed entrepreneurs, depicting a context in which a wage bargaining process may not take place. Because of this feature, the model that guides our study does not capture some potential spill-over effects of these policies on the informal sector; hence, we limit ourselves to present evidence about some direct effects of these policies on the formal sector. One of the main virtues of this model is that the informal sector is not treated as a parallel disadvantaged residual of the formal sector; rather, the formal and the informal sectors are deeply intertwined, and workers may transit between them following optimizing behavior.

We stress that a job search and matching model such as the one that we present here sheds interesting light on the direct mechanisms of these policies, which may be quite useful for policy purposes as it allows to simulate the configuration of the labor market in absence of benefits for informal workers. Our results may thus depict lower bounds for the effects of these policies in the sense that positive spill-overs on the informal sector may yield improvements of workers' livelihoods beyond what we manage to gauge in this study. Perhaps, one particularly important mechanism for these effects is what the

related literature terms the *lighthouse effect* (Souza & Baltar, 1979), which consists of setting higher references for salaries throughout economy induced by minimum wage increases. This effect is well documented in Latin America (see e.g. Maurizio & Vasquez, 2016; Maloney & Mendez, 2004) and it has been found to touch not only informal sectors but also illegal sectors that are not directly bound to the minimum wage. We are well aware of the fact that this kind of effects may be quite important in the Bolivian economy and we intend to build upon our current results to take them into account in future research.

Another important direction for future research, grounded on the evidence that we present in this document, is related to the fact that in a setting where firms combine different types of workers that are not perfect substitutes of each other, then active minimum wages may lead to overemployment of a certain type of workers searching for means to press wages downwards (see Bauducco & Janiak, 2015). Furthermore, active minimum wages may also expand the demand for capital due to factor interrelations in the production process. A minimum wage increase may also imply changes in labor force participations and time-use decisions by potential workers. We believe that these effects deserve further attention in future research and we intend to expand the results that we present here along these lines.

Finally, we defend the idea that the configuration of job market cannot be assessed only on the grounds of economic modeling techniques such as the one that we present here. However, we also defend the idea that these analyses are of paramount importance towards more detailed and precise discussions on this subject, as they provide logical and robust frameworks that are exempt of personal judgments and political perspectives. We

intend to keep on undertaking studies in this sense and perfecting our analytical tools, as we are convinced that they offer robust insights towards effective policymaking for better jobs.

## 6. References

- Albrecht J., M. Robayo-Abril, and S. Vroman. (2017). “Public-sector employment in equilibrium search and matching model”, *The Economic Journal*, forthcoming issue.
- Albrecht J., L. Navarro, and S. Vroman. (2009). “The effects of labor market policies in an economy with informal sector”, *The Economic Journal*, Vol. 119 (539); 1105-1129.
- Andersen, L., and B. Muriel. (2007). “Informality and productivity in Bolivia: A gender differentiated analysis”, *Development Research Working Paper Series 07/2007*, INESAD.
- Bauducco S., and A. Janiak. (2015). “The impact of the minimum wage on capital accumulation and employment in a large-firm framework”, *Working Papers Central Bank of Chile N° 755*.
- Bigsten A., P. Kimuyu, and K. Lundvall. (2000). “Informality, ethnicity and productivity: evidence from small manufacturers in Kenya”, *Working Paper Series*, Department of Economics, Gotheburg University, Sweden.
- Bosch M. and J. Esteban-Pretel (2012). “Job creation and job destruction in the presence of informal markets”, *Journal of Development Economics*, Vol. 98(2): 270-286.
- Busso M., M. Fazio, and S. Levy. (2012). “(In)Formal and (Un)Productive: The Productivity Costs of Excessive Informality in Mexico”, *Research Department Publications N° 4789*, IADB.

- Castex G., and M. Ricaurte. (2011). “Self – Employment, Labor Market Rigidities and Unemployment Over the Business Cycle”, *Working Papers Central Bank of Chile N° 650*.
- Chong A., J. Galdo, and J. Saavedra. (2007). “Informality and Productivity in the Labor Market: Peru 1986-2001”, *Working Paper N° 609*, Research Department, IADB.
- Diamond, P. (1982). “Wage determination and efficiency in search equilibrium”, *Review of Economic Studies*, Vol. 49; 217-27.
- Frolich, M., D. Kaplan, C. Pagés, J. Rigolini, and D. Robalino. (2014). *Social insurance, informality and labor markets: How to protect workers while creating good jobs*, Oxford University Press, UK.
- Gong, X., A. Van Soest, and E. Villagómez. (2004). “Mobility in the urban labor market: A panel data analysis for Mexico”, *Economic Development and Cultural Change*, Vol. 53(1); 1-36.
- Heckman, J., and C. Pagés. (2004). “Introduction to "Law and Employment: Lessons from Latin American and the Caribbean” In *Law and Employment: Lessons from Latin America and the Caribbean*: 1-108. NBER.
- Hendy R., and C. Zaki. (2013). “On informality and productivity of micro and small enterprises: Evidence from MENA countries”, *International Journal of Entrepreneurship and Small Business*, Vol. 19(4); 438-470.
- ILO. (2013). *Panorama Laboral 2013*, América Latina y el Caribe, OIT, Lima – Peru.
- Leal, J.C. (2014). “The informal sector in contemporary models of the aggregate economy”, *Working Papers N° 24*, Banco de México.
- Maloney W., and J. Mendez. (2004). “Measuring the impact of minimum wages. Evidence from Latin America”, In *Book Law and Employment: Lessons from Latin America and the Caribbean*, University of Chicago Press: 109-130.

- Maloney, W. (2004). "Informality revisited", *World Development*, Vol. 32(7); 1159-1178.
- Masatlioglu, Y., and J. Rigolini. (2008). "Informality traps", *The BE Journal of Economic Analysis and Policy*, Vol. 8(1); 1-24.
- Mercado, A., L. Andersen, and B. Muriel. (2003). "Discriminación étnica en el sistema educativo y el mercado de trabajo en Bolivia", *Revista Latinoamericana de Desarrollo Económico*, Vol. 1; 63-98.
- Maurizio R., and G. Vazquez. (2016). "Distribution effects of the minimum wage in four Latin American countries: Argentina, Brazil, Chile and Uruguay", *International Labour Review*, Vol. 155(1): 97-131.
- Mortensen, D., and C. Pissarides. (1994). "Job creation and job destruction in the theory of unemployment", *Review of Economic Studies*, Vol. 61(3); 397-415.
- Muriel B. (2014). "Empleo y regulación laboral: análisis empírico de las firmas manufactureras bolivianos 1988-2007", *Revista Latinoamericana de Desarrollo Económico*, Vol. 12(21).
- Tornarolli L., D. Battistón, L. Gasparini, and P. Gluzmann. (2014). "Exploring trends in labor informality in Latin America, 1990-2010", *Documento de Trabajo N° 159*, CEDLAS.
- Román, S. (2011). "Costos laborales, economía informal y reformas a la legislación laboral en Bolivia", *Development Research Working Paper Series N° 8*, INESAD.
- Souza, P., P. Baltar. (1979). Salario mínimo e taxa de salários no Brasil. *Pesquisa e Planejamento Economico*, Vol 9: 629-60.
- World Bank. (2015). *Doing business report 2015: Going beyond efficiency*, 12th Edition, The World Bank.

## 7. Appendix 1: Robustness check with 2015 data

Following an approach similar to the 2013 calibration, we aimed at reproducing 2015 data through are model. The propose parameters the following values for the parameters, justified by the same logic presented in the document:

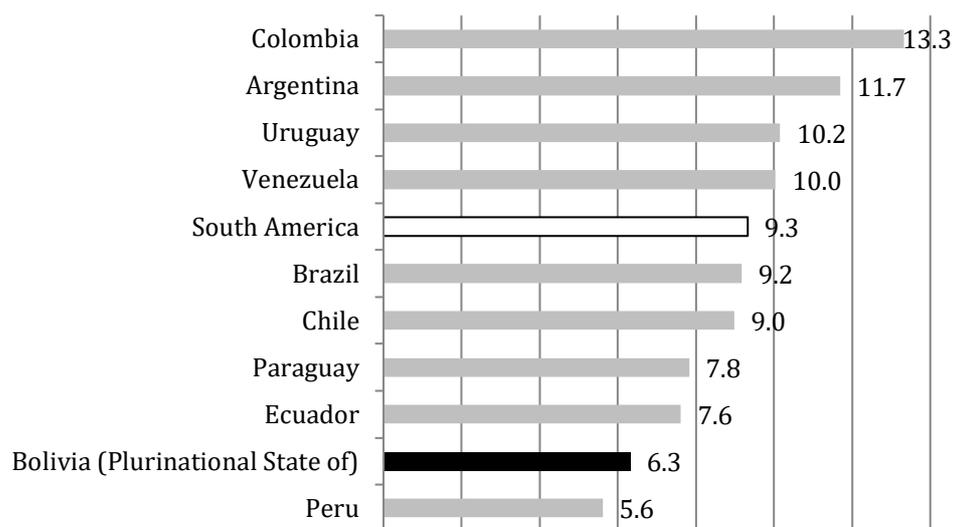
- The discount rate,  $r$ , is set to 4.8%
- The elasticity of the number of matches per year with respect to the market tightness, denoted as  $\beta$ , and the bargaining power by workers, denoted as  $\gamma$ , are both set set to 0.5.
- Given that the median unemployment duration of the urban workforce is 3.4 months in 2015, we set  $A$  to 2.123.
- The income flow of informal workers,  $y_0$ , is set to 0.43.
- The rate of job destruction in the informal sector,  $\delta$ , is set to 0.25.
- The arrival rate of productivity shocks in the formal sector,  $\lambda$ , is set to 0.2.
- The rate of arrival of employment opportunities in the informal sector,  $\alpha$ , is set to 6 in order to replicate the unemployment rate of 4.37%.
- The cost of a vacancy for the firm,  $c$ , is set to 0.2.
- The severance tax,  $s$ , is set to 5%.
- The payroll taxes coefficient,  $\tau$ , is set to 44.9% as it comprises the 13<sup>th</sup> salary (8.33%), the prime for insurance against professional risks at work (1.71%), the contribution the subsidized housing program (2%), the compensation for removal from post (8.33%), the contribution to the national health system (10%), the contribution to 'Fondo Solidario' (3%), the 14<sup>th</sup> salary (8.33%) and an effective 3.2% minimum wage increase between 2014 and 2015.

- Coefficient  $\xi$  is set to 28.49% as it comprises payroll taxes included in  $\tau$  that have a direct impact on the workers' salaries, namely the 13<sup>th</sup> and 14<sup>th</sup> salaries, minimum wage increases and compensations for removal from post.

[Table 4 Here]

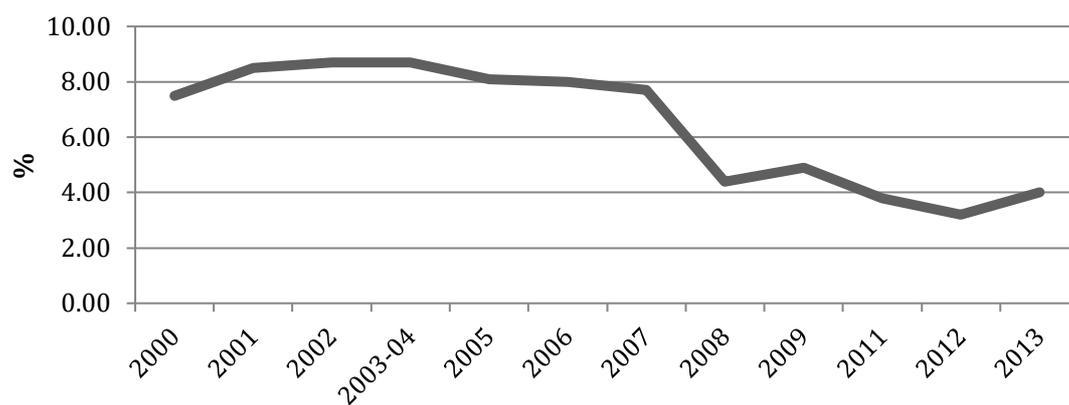
[Table 5 Here]

Figure 1. Average unemployment rates in South America (% , 2000-2013)



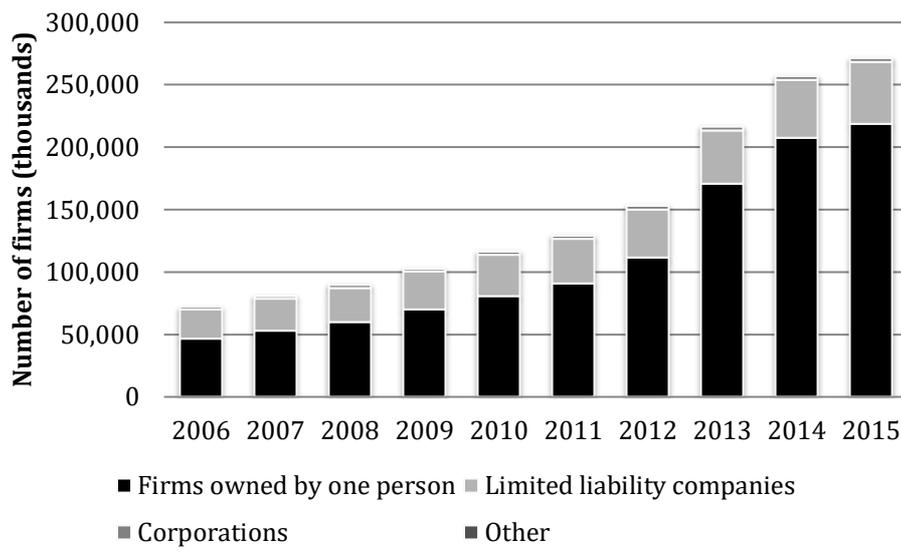
Source: Economic Commission for Latin America and the Caribbean – ECLAC

Figure 2: Urban unemployment rates (% , 2000-2013)



Source: Ministry of Economics (unemployment rate)

Figure 3: Number of operating firms by type (2006-2015)



Source: FundEmpersa (Memoria Institucional 2015)

Table 1: Model-generated statistics vs. real 2013 data

<b>Statistic</b>	<b>Model-generated</b>	<b>2013 actual (source)</b>
Total Unemployment rate	4.05 %	4.02% (National Institute of Statistics)
Unemployment rate, Low productivity	4.00%	3.70 % (Household Survey, education level up to incomplete secondary education)
Unemployment rate, Medium productivity	2.41%	3.65 % (Household Survey, education level from complete secondary up to technical)
Unemployment rate, High productivity	4.80%	4.71% (Household Survey, education level higher than technical)
Informality rate	72 %	71% (not covered by pension system urban only, Household survey)
Duration of unemployment	3.42 months	4 months (Household Survey, median urban employment)

Source: Own calculations, 2013 household survey and National Institute of Statistics.

Table 2: Model output for each scenario (2013)

		<b>Baseline Scenario (2013)</b>	<b>Counter-factual Scenario 1</b>	<b>Counter-factual Scenario 2</b>	<b>Counter-factual Scenario 3</b>
Policy parameters	$\tau$	45.20%	41.70%	33.37%	30.37%
	s	5.00%	5.00%	5.00%	5.00%
	$\xi$	28.49%	24.99%	16.66%	16.66%
Model Output (Selected)	$\theta$	1.37	1.41	1.50	1.52
	$y^*$	0.60	0.59	0.55	0.54
	$y^{**}$	0.72	0.69	0.65	0.64
	$R(y^{**})$	0.62	0.60	0.56	0.55
Workforce distribution by level of productivity	Low	60.47%	59.03%	55.62%	54.40 %
	Medium	11.23%	10.84%	9.90%	9.69%
	High	28.30%	30.13%	34.40%	35.91%
Unemployment rates, total and by level of productivity	Low	4.00 %	4.00 %	4.00 %	4.00 %
	Medium	2.41 %	2.23 %	2.26 %	2.28%
	High	4.80 %	4.75 %	4.58 %	4.49%
	Total	4.05 %	4.04 %	4.02%	4.00%
Probability of informal employment by level of productivity	Low	96.00%	96.00%	96.00 %	96.00 %
	Medium	52.67%	52.48%	51.85%	51.61%
	High	0.00%	0.00%	0.00%	0.00%
Probability of formal employment by level of productivity	Low	0.00%	0.00%	0.00%	0.00%
	Medium	45.14%	45.33 %	45.98%	46.23%
	High	95.30%	95.36 %	95.48%	95.51%
Duration of unemployment (Months)		3.42	3.37	3.27	3.24
Mean formal wage (0-1 continuum)		0.527	0.535	0.555	0.564
Formal wage standard deviation		0.065	0.070	0.082	0.086
Matching Function Output		3.51	3.56	3.67	3.70

Source: Own

Table 3. Reconfiguration of number of workers by type

	<b>Baseline Scenario (All three policies are active)</b>	<b>Change without minimum wage increases (counterfactual 1 vs. baseline)</b>	<b>Change without of 14<sup>th</sup> salary (counterfactual 1 vs. counterfactual 2)</b>	<b>Change without of contributions to “Fondo Solidario” (counterfactual 2 vs. counterfactual 3)</b>	<b>Total change in absence of all three policies (counterfactual 3 vs. baseline)</b>
Permanent Informal	1'924'268	+ 58'823	+ 135'879	+ 48'051	+ 242'164
Potential Informal	357'360	- 12'411	- 29'913	-6'683	- 49'006
Permanent Formal	900'559	- 45'823	- 108'513	- 38'823	- 193'159
Economically Active Population	3'182'187				

Source: Own calculations

Table 4: Model-generated statistics vs. real 2015 data

<b>Statistic</b>	<b>Model-generated</b>	<b>2015 actual (source)</b>
Total Unemployment rate	4.37%	4.38% (National Institute of Statistics)
Unemployment rate, Low productivity	4.00%	3.54% (Household Survey, education level up to incomplete secondary education)
Unemployment rate, Medium productivity	2.70%	4.48 % (Household Survey, education level from complete secondary up to technical)
Unemployment rate, High productivity	6.14%	5.18% (Household Survey, education level higher than technical)
Informality rate	74.42%	76.17% (Household Survey, pop. not covered by pension system urban only)
Duration of unemployment	4.69 months	3.4 months (Household Survey, mean urban employment)

Source: Own calculations, 2015 household survey and National Institute of Statistics.

Table 5: Model output for each scenario (2015)

		<b>Baseline Scenario (2015)</b>	<b>Counter-factual Scenario 1</b>	<b>Counter-factual Scenario 2</b>	<b>Counter-factual Scenario 3</b>	<b>Qualitative Effect compared to 2013</b>
Policy parameters	$\tau$	44.90%	41.70%	33.37%	30.37%	
	s	5.00%	5.00%	5.00%	5.00%	
	$\xi$	28.19%	24.99%	16.66%	16.66%	
Model Output (Selected)	$\theta$	1.45	1.50	1.60	1.65	
	$y^*$	0.60	0.59	0.56	0.54	
	$y^{**}$	0.74	0.73	0.68	0.66	
	$R(y^{**})$	0.61	0.60	0.56	0.55	
Workforce distribution by level of productivity	Low	60.35%	59.04%	55.62%	54.40 %	
	Medium	14.07%	13.59%	12.50%	12.07%	
	High	25.58%	27.37%	31.88%	33.53%	
Unemployment rates, total and by level of productivity	Low	4.00 %	4.00 %	4.00 %	4.00 %	
	Medium	2.71 %	2.60 %	2.60 %	2.66%	Same
	High	6.14 %	6.00 %	5.58 %	5.22%	Same
	Total	4.37 %	4.35 %	4.33%	4.25%	Same
Probability of informal employment by level of productivity	Low	96.00%	96.00%	96.00 %	96.00 %	
	Medium	58.89%	58.69%	58.05%	57.61%	Same
	High	0.00%	0.00%	0.00%	0.00%	
Probability of formal employment by level of productivity	Low	0.00%	0.00%	0.00%	0.00%	
	Medium	38.66%	38.86 %	39.53%	40.00%	Same
	High	93.95%	94.02 %	94.17%	94.23%	Same
Duration of unemployment (Months)		4.69	4.61	4.47	4.40	Same
Mean formal wage		0.523	0.530	0.551	0.560	Same
Standard deviation of formal wage		0.061	0.065	0.077	0.081	Same
Matching Function Output		2.56	2.60	2.69	2.73	Same

Source: Own