The Informal Labor Market in Latin-America*

Mariano Bosch
London School of Economics

Julen Esteban-Pretel†
University of Tokyo

Ocotober 2006

Abstract

The informal sector in developing countries is found to be a substantial fraction of the economy. In Latin American countries such as Brazil or Mexico the informal labor market employs over 40 percent of the workers and the data shows high flows of workers from unemployment to both sectors, but also between formal and informal jobs. This paper builds a two-sector search and matching model with on-the-job search which is able to replicate the cross-correlations of the main worker flows the the Brazilian economy over the business cycle. We also show how some policy changes can lead to variations in the level of formality and unemployment in the long-run.

Keywords: Informal Labor Market, Latin America, Search and Matching, Cyclical Fluctuations
JEL Classification: E32, J42, J64

*We are greateful to Chris Pissarides and Toni Braun and attendants at the Institute of Statistical Research workshop for helpful coments. The authors would like to acknowledge financial support from the Nomura Foundation. All errors are our own.

†Corresponding author: Faculty of Economics, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan. E-mail: julen@e.u-tokyo.ac.jp

1 Introduction

Data on worker flows suggests that in aggregate labor markets in developing countries, such as Brazil or Mexico, are reasonably similar to US labor market. Flows from unemployment into employment have a strong pro-cyclical pattern and flows out of employment are counter-cyclical. Further, the volatility of the unemployment rate is also similar in all three countries. However, around 40 percent of total employment in Mexico and Brazil are working in informal jobs unprotected by the regulatory framework. Important insights emerge when we analyze separately informal and formal employment. Firstly, although job finding rate in the formal sector is still strongly pro-cyclical, the job finding rate in the informal sector is much less volatile and shows no profound cyclical pattern. Secondly, informal workers are exposed to higher risk and volatility. Job separation rate in the informal sector is between 2 to 3 times higher than that of formal employment and it is several times more volatile than the formal job separation rate. Finally, the share of formal employment is pro-cyclical. This is especially relevant for policy makers in developing countries at least for three reason: Informal jobs have low productivity and hence, can be detrimental for overall economic growth; informal workers are subject to higher levels of job separation and lack any protection from the legal system; and finally, informal jobs are not taxed and, therefore, do not contribute to government revenues.

Two main reasons are put forward for the prominence of the informal sector in developing countries. First, the tax and social security contributions burdens has been pointed out by a number of studies, as one of the major sources of generation of informal employment(see Schneider, 2005) Second, intensity of regulation also has been identified as one of the main determinants of the

size of the informal sector. Indeed, there is a strong positive correlation between the number and strictness of laws workers and firms have to observe to participate in the formal economy and the size of the informal sector at the country level. See Johnson et. al. (1998).

The dominant perspective equates the informal sector with underemployment or disguised unemployment (see Harris and Todaro, 1970, Lewis, 1954). It has been considered the disadvantaged sector of a market segmented by rigidities in the formal or covered sector of the economy. However, intersectorial flows between formal and informal jobs seem to suggest otherwise. Direct transitions from informal jobs to formal jobs are pro-cyclical. But strikingly, transitions between formality and informality are not counter-cyclical. In fact, there are clearly pro-cyclical in Brazil and acyclical in Mexico, whis seems to contradict the segmented labor market view. If informality is the disadvantaged sector in a segmented labor market, then, transitions of workers from formal jobs into informal jobs must, necessarily, be involuntary. Therefore, an improvement in macroeconomic conditions should generate a decrease in the intensity of transitions from formal employment into informal employment.

The aim of this paper is to study and model the cyclical behavior of labor markets variables and flows in countries with high proportion of informality, such as Brazil and Mexico. In this sense our paper is related to a growing literature dealing with the particularities of informal labor markets. Recent examples of this literature include Boeri and Garibaldi (2006), Antunes and Cavalcanti (2006), Klom and Larsen (2002), Albercht et al.(2006), and Bosch (2005, 2006). However, this literature focuses mainly on the steady state impact of labor regulations in markets where a significant proportion of jobs are held in the informal sector. Our paper, on the other hand, is

not only interested in the study of government policies in the long run, but also on the short-term behavior of job market variables and flows. In particular we focus our attention in flows between sectors, that is, from the formal to the informal and vice-versa.

This paper is hence also related to the extensive literature of on-the-job search. Mortensen (1994), Pissarides (1994) or more recently, Krause and Lubik (2006) and Nagypal (2006) develop models which deal with worker flows during employment. On-the-job search has been suggested primarily to acknowledge the empirical fact that job-to-job transitions are at least as large as those from unemployment into employment (Nagypal, 2005). However, Krause and Lubik (2006) and Nagypal (2006) show that introducing on-the-job search considerably improves the quantitative performance of the standard model in replicating the cyclical behavior of unemployment and vacancies, point in which Shimer (2005) and Hall (2005) claim the standard search and matching model fails.

In this paper we first analyze the main empirical facts of formal and informal labor markets in Brazil and Mexico and compare them with the facts about the U.S. labor market. We then develop a model which allows us to study those data findings from a theoretical viewpoint and we finally perform some policy experiments to better understand the role of the different aspects of the model in the equilibrium outcome.

The model developed in this paper is a discrete time, two-sector search and matching model with endogenous job destruction and on-the-job search. As in Mortensen and Pissarides (1994) the productivity of each match is a function not only of the aggregate technology level, but also of the idiosyncratic productivity level of the match. Aggregate technology shocks are the only

source of fluctuation in the model. The formal sector differs from the informal in that it has higher aggregate productivity and it is more regulated, with higher cost of posting vacancies, and the existence of firing costs and labor income taxes. Endogenous job destruction and taxes are two of the key features of the model when generating empirically consistent intersectorial flows, especially from the formal to the informal sector. The intuition behind these intersectorial on-the-job transitions is as follows. Direct transitions from informal jobs into formal jobs are determined by the creation of vacancies in formal firms. A boom fosters the creation of vacancies in the formal sector. This increases the probability of informal workers getting a formal sector job, generating the pro-cyclicality observed in the data. The inverse transitions, from formal to informal jobs, are the result of three different effects. The state of the formal job market, the creation of vacancies in the informal sector and the incentives to search for formal workers, which is where idiosyncratic productivity and taxation are important. As is traditional in on-the-job search models, a boom increases the search activity. Moreover, higher overall productivity means more employment opportunities in both the formal and the informal sectors. The fact that more workers are searching and the additional creation of vacancies in the informal sector tends to increase the flows from informality into formality. However, we assume sequential search with workers searching first in the formal and then in the informal sectors. This assumption implies that since workers initially search in the formal sector, the higher probability of getting a formal job lowers the number of potential searchers that can be matched with an informal firm. In all, the transitions from formal into informal jobs may increase or decrease. These transitions from formal into informal jobs are, essentially, voluntary. Although the good formal jobs are always preferred, workers prefer to take

a good employment opportunity in an informal job than to stay in a low productivity, tax-paying formal job.

Calibrating the model to Brazilian data and simulating the model, we show that it can successfully generate the cross correlations of the main worker flows observed in the data. Interestingly, the model generates pro-cyclical bilateral flows between the formal and the informal sectors. However, it tends to underestimate the volatility of most of the series. We perform three different policy experiments, which show that decreasing firing costs, labor income tax rates, the cost of posting vacancies in the formal sector, or increasing them in the informal would all increase the size of the formal economy. However the results on unemployment are diverse. Dropping taxes or increasing the cost of posting vacancies in the informal market decrease unemployment, while reducing firing costs or the cost of posting vacancies in the formal sector increases unemployment. It is also interesting to note that in the case of the tax change, due to the increase in the number of tax paying workers, the total government tax revenue increases, but only as long as the tax cut is not too big, suggesting the existence of a Laffer curve type problem in these economies, given our calibration.

The remainder of the paper is organized as follows. Section 2 presents the empirical evidence on the formal and informal labor markets. Section 3 develops the model. Section 4 explains the calibration. Section 5 shows the simulation results. Section 6 explains the policy experiments results and Section 7 concludes. A brief description of the data can be found in the Data Appendix.

2 Empirical Evidence

The data used to construct worker flows in Brazil and Mexico is obtained from rotating panels of the urban labor surveys in each country (see data appendix for details). The questionnaire is extensive in its coverage of participation in the labor market, wages, hours worked, etc. that are traditionally found in such employment surveys. Two main advantages of these surveys make them especially useful for this paper. First, they allow us to distinguish between formal and informal workers. We classify as informal employment those workers without benefits and social security protection. Second, similar to the Current Population Survey (CPS) in the U.S. they track individuals for a number of periods so we can estimate the transition probabilities between different sectors of employment.

In order to allow a clear cut comparison across markets Table1 shows the cyclical properties of unemployment and flows in and out of unemployment for Brazil and Mexico compared to those of the U.S.[1] The data suggest that these two Latin American markets follow similar patterns of those in the U.S. The levels of unemployment and flows in and out of unemployment are in the same range of values. Moreover, the volatility of unemployment is very similar in all three countries. Similarly, the job finding rate is highly pro-cyclical whereas the job separation rate is counter-cyclical. However, there are also noticeable differences. First, the job finding rate in the formal sector almost three times as volatile as the job finding rate in Brazil and Mexico. The high volatility of the job finding rate has been a topic of debate since Shimer (2005) argued that the

[1]U.S. data was constructed by Robert Shimer. For additional details, please see Shimer (2005) and his webpage http://home.uchicago.edu/~shimer/data/flows/.

standard Pissarides (1985) model cannot quantitatively account for the volatility of the vacancy to unemployment ratio in the U.S. One of the main explanations put forward is that wages in this model are considered to be extremely flexible. The use of sticky wages substantially improves the performance of the model. Evidence suggests that wages are indeed stickier in the U.S. than in the two Latin American labor markets studied here. This could be at the root of the differences in volatility. Second, the job separation rate although counter-cyclical in all three countries, is only weakly correlated with unemployment in the U.S., 0.3, whereas the correlation in both, Brazil and Mexico, is extremely high, 0.9.

Table 1

When we divide the labor market between the formal and the informal sectors new facts emerge, as is shown in Table 2. First, we find that a high proportion of the flows out of unemployment are towards the informal sector. Second, the job separation rate in the informal sector is between 2 to 3 times higher than that of the formal sector We also find that the high pro-cyclicality of the aggregate job finding rate is generated by the formal sector. The job finding rate is weakly pro-cyclical in Brazil, weakly counter-cyclical in Mexico and more volatile in the latter country. Conversely, the high correlation between unemployment rate and the job separation rate comes from the behavior of the job separation rate in the informal sector. Not only is the job separation rate higher in the informal sector but it is also more volatile. This highlights the higher vulnerability at which informal workers are subject to. Finally, we also present data on direct flows between formal and informal jobs. As expected, the flow from informal into formal jobs follows a pro-cyclical pattern. Very much like the flow from unemployment into formal employment. However, the flow from

formal into informal jobs is not counter-cyclical, as one would expect from the segmented markets theories of Harris and Todaro. In fact it is clearly pro-cyclical in Brazil and acyclical in Mexico. This suggests that some of the direct transitions between formal and informal employment must be voluntary. Moreover, the relative volatilities of the transitions follow a similar pattern to those from unemployment. Lastly, direct flows towards formality are more volatile than those towards informal employment.

Table 2

Policy changes are also relevant for this paper. The accumulated evidence on the impact of policy interventions in Latin American markets suggests that generating higher degrees of flexibility reduces the size of the informal sector[2]. Although Mexico did not present any significant labor reform during the period under scrutiny, Brazil did. The 1988 constitutional reform had important implications for the labor code in several areas. First, maximum working hours per week were reduced from 48 to 44, the maximum daily work day was reduce from 8 to 6 hours, overtime remuneration was increased from 1.2 to 1.5 times the normal wage rate; vacation pay was raised from 1 to four thirds of the monthly wage, and maternity license increased from 90 to 120. Second, union power was expanded, allowing unions to play a more active role in determining working conditions. Finally, firing costs were raised. The penalty levied on employers for "unjustified" dismissal, a category encompassing most legitimate separations for economic reasons in the U.S., increased by four times. One of the consequences of these reforms was a drop in the share of formal employment from 65% to 53% of the labor force.

[2]See Heckman and Pages (2003) for an extensive review.

In the following section we build a model of the labor market to try to account for the empirical regularities just explained and to serve as a base for the policy experiments conducted later.

3 The model

3.1 Environment

This is a discrete time two-sector search and matching labor market model with infinitely lived risk-neutral agents. The two sectors in the economy are the formal and the informal. The formal sector is characterized by higher productivity, firing restrictions, taxation and higher cost of entry for firms.

There are two types of agents, workers and firms. They engage in employment relationship, which consist of one worker and one firm, but to do so they need to undergo a costly process of search in the labor market. Vacant firms and workers meet randomly according to a matching function $m^k(s_t^k, v_t^k)$, where s_t^k is the number of workers searching in sector $k \in \{f, i\}$ and v_t^k is the number of vacancies posted in that sector. The matching function is assumed to be constant returns to scale, which implies $m^k\left(s_t^k, v_t^k\right) = m^k\left(1, \frac{v_t^k}{s_t^k}\right) s_t^k = m^k\left(\theta_t^k\right) s_t^k$, where $\theta_t^k = \frac{v_t^k}{s_t^k}$ is the market tightness of sector k.

If the matching process is successful they start producing the following period. The productivity of the match is a function of the aggregate productivity of the sector A_t^k and an idiosyncratic term to the match, x. The firm specific productivity term is independent and identically distributed across firms and time, with distribution function $G : [0, \infty] \to [0, 1]$, which is common to both sectors. A new idiosyncratic productivity is drawn every period by existing matches, except for

newly formed ones that start at the maximum productivity[3]. Employment relationships are severed endogenously when the productivity of the match is below a certain threshold, $\bar{x}_t^k$.

Workers who are employed are allowed to search for better job opportunities. However, searching for new jobs while working has a positive cost. This cost is higher in the formal than in the informal sector and is assumed to be an increasing function of the productivity of the match. For simplicity we assume that the cost of on-the-job search in the informal sector is zero. Given the lack of search cost in the informal sector, all the workers in this sector, n_t^i, perform on-the-job search, whereas the formal sector on-the-job search cost, $\sigma(x)$, divide formal workers between searchers, n_t^s, and non-searchers, n_t^n. There is a threshold idiosyncratic productivity level, x_t^s, above which the formal worker will not find it optimal to search.

Search in the two sectors is sequential. First, the formal sector opens and formal vacancies try to match with formal sector searchers, $s_t^f = u_t + n_t^s + n_t^i$, where u_t is the number of unemployed workers in the economy. Searchers who remain unmatched after the formal labor market closes can then search in the informal sector. Define $p_t^k = \theta_t^k m^k\left(\theta_t^k\right)$ as the probability for a searcher in sector k to match with a firm, then the number of searchers in the informal sector are $s_t^i = \left(1 - p_t^f\right)\left(u_t + n_t^s + n_t^i\right)$.

We model the firing restrictions as a lump sum cost, F, incurred by the firm in case the employment relationship is severed. This cost is not paid to the worker, but assumed to be wasted resources. In order to simplify the structure of the model and avoid the insider/outsider wages described in Mortesen and Pissarides (2003) this firing cost is assumed to be in effect the moment

[3]Vacancies are costly to set up and if firms know their initial idyosincratic productivity if matched, free entry of firms implies that posting vancies is optimal only for firms with maximum idyosincratic productivity.

the match is formed. Hence, if following a match between a firm and a worker, an employment relationship is not formed, the cost has to be incurred. Taxes are modeled as proportional labor income taxes paid by the worker. Government is not modeled and hence this tax revenues are assumed to be devoted to issues outside the model.

The timing of the model is as follows. At the beginning of the period firms which had been producing during the previous period draw a new idiosyncratic productivity. This new productivity along with the aggregate sector productivity determines destruction for the period. After destruction takes place, the levels of employment and unemployment are determined. At that point production takes place in the existing employment relationships and also the formal labor market opens. Firms with a vacancy in the formal sector and formal sector searchers try to match. If the match is successful, they will start producing the following period. Searchers who do not match with firms in the formal sector can then search in the informal one. If they match with a vacancy, they start the employment relationship the following period. If they do not succeed to match, they wait until the following period to search again.

3.2 Value Functions

Now that we know the environment of the economy, we can study the value for firms and workers to be in every one of the states.

3.2.1 Workers

Denote the value of being unemployed by U_t. A Worker without a job receives a flow value of being unemployed of z. He tries to match with formal firms at the beginning of the period. If

he matches, which occurs with probability p_t^f, the following period he receives the value of being employed in a formal firm. Since formal firms have the highest aggregate productivity and newly formed matches start at the maximum idiosyncratic productivity, the positive on-the-job search cost makes the worker in a newly formed matched not be willing to search. Hence, he obtains a value of $W_{t+1}^n(x_{\max})$. If the unemployed worker does not match with a formal firm, he then searches in the informal sector. Conditional on being a searcher in that sector, he matches with a firm with probability p_t^i and if that occurs the following period he obtains a value of $W_{t+1}^i(x_{\max})$. If he does not match in any of the two sectors he remains unemployed for one more period. Hence the value of an unemployed worker which discounts the future at rate β is

$$U_t = z + \beta E_t \left[p_t^f W_{t+1}^n(x_{\max}) + \left(1 - p_t^f\right) p_t^i W_{t+1}^i(x_{\max}) + \left(1 - p_t^f\right)\left(1 - p_t^i\right) U_{t+1} \right]. \quad (1)$$

Employed workers can be in one of the three following states: hired formally and not doing on-the-job search, hired formally but searching for better job, and hired informally. The values for each of these states are a function of the idiosyncratic productivity of the specific match, x, and are respectively denoted by $W_t^n(x)$, $W_t^s(x)$ and $W_t^i(x)$.

A non-searching formal worker receives wage $w_t^n(x)$ out of which he is a taxed a fraction τ. The following period the firm draws a new idiosyncratic productivity. If the new value of x is above the search threshold, x_{t+1}^s, he remains formally employed and does not search. If x is between the destruction, $\bar{x}_{t+1}^f$, and search thresholds he keeps working for the same formal firm, but will search while working. Finally, if x is below the destruction threshold he becomes unemployed. Hence the

value of employment for a worker who does not search on the job is

$$W_t^n(x) = (1-\tau)\, w_t^n(x) + \beta E_t \left[\int_{\bar{x}_{t+1}^f}^{x_{t+1}^s} W_{t+1}^s(s)\, dG(s) + \int_{x_{t+1}^s}^{x_{\max}} W_{t+1}^n(s)\, dG(s) + G\left(\bar{x}_{t+1}^f\right) U_{t+1} \right]. \tag{2}$$

When a worker is being hired in the formal sector by a firm with low idiosyncratic productivity he receives after-tax wage $(1-\tau)\, w_t^s(x)$ and finds it optimal to incur in the search cost, $\sigma(x)$, to try to find a better match. As unemployed and informal workers do, he searches for a new job first in the formal and then in the informal sector. If not matched with a new firm, the following period the worker obtains the same continuation value as a non-searching formal worker.

$$\begin{aligned} W_t^s(x) &= (1-\tau)\, w_t^s(x) - \sigma(x) + \beta E_t \left[p_t^f W_{t+1}^n(x_{\max}) + \left(1-p_t^f\right) p_t^i W_{t+1}^i(x_{\max}) \right] \\ &\quad + E_t \left(1-p_t^f\right)\left(1-p_t^i\right) \left[\int_{\bar{x}_{t+1}^f}^{x_{t+1}^s} W_{t+1}^s(s)\, dG(s) + \int_{x_{t+1}^s}^{x_{\max}} W_{t+1}^n(s)\, dG(s) + G\left(\bar{x}_{t+1}^f\right) U_{t+1} \right]. \end{aligned} \tag{3}$$

A worker employed in the informal sector receives wage $w_t^i(x)$ for his work. He always searches for better job opportunities first in the formal and then in the informal sector. If he does not match in either sector and the idiosyncratic productivity of the following period is high enough, he remains employed as an informal worker, if it is below the threshold $\bar{x}_{t+1}^i$, he will become unemployed.

$$\begin{aligned} W_t^i(x) &= w_t^i(x) + \beta E_t \left[p_t^f W_{t+1}^n(x_{\max}) + \left(1-p_t^f\right) p_t^i W_{t+1}^i(x_{\max}) \right] \\ &\quad + \beta E_t \left(1-p_t^f\right)\left(1-p_t^i\right) \left[\int_{\bar{x}_{t+1}^i}^{x_{\max}} W_{t+1}^i(s)\, dG(s) + G\left(\bar{x}_{t+1}^i\right) U_{t+1} \right]. \end{aligned} \tag{4}$$

Note that the value of employment for a searching employed worker assumes that if matched with a new formal or informal firm he moves to this new job. Given that new matches start at the

maximum productivity, a worker will always accept an offer from the sector where he is currently employed. However, for a formal worker to take an offer from an informal firm the following condition should be satisfied:

$$W_{t+1}^{i}\left(x_{\max}\right) \geq \int_{\bar{x}_{t+1}^{f}}^{x_{t+1}^{s}} W_{t+1}^{s}\left(s\right) dG\left(s\right) + \int_{x_{t+1}^{s}}^{x_{\max}} W_{t+1}^{n}\left(s\right) dG\left(s\right) + G\left(\bar{x}_{t+1}^{f}\right) U_{t+1}. \tag{5}$$

Likewise, the following inequality should be satisfied for an informal worker to accept a formal job,

$$W_{t+1}^{n}\left(x_{\max}\right) \geq \int_{\bar{x}_{t+1}^{i}}^{x_{\max}} W_{t+1}^{i}\left(s\right) dG\left(s\right) + G\left(x_{t+1}^{i}\right) U_{t+1}.$$

The previous conditions are satisfied for the results shown in this paper.

3.2.2 Firms

Firms post vacancies in either the formal or the informal markets. Denote the value of being a vacant firm in sector k by V_t^k and the probability for a vacancy in that sector to match with a worker by $q_t^k = \dfrac{m^k\left(\theta_t^k\right)}{\theta_t^k}$.

Posting a vacancy in the formal sector has a flow cost c_f. If matched with a worker the following period the firm obtains the value of being a productive firm in the formal sector with maximum productivity, $J_{t+1}^{n}(x_{\max})$. If it does not match it remains as a vacancy. Hence the value of a vacancy in the formal sector is

$$V_t^f = -c_f + \beta E_t\left[q_t^f J_{t+1}^{n}(x_{\max}) + \left(1 - q_t^f\right) V_{t+1}^f\right]. \tag{6}$$

Similarly, the flow cost of posting a vacancy in the informal sector is c_i. If the search is successful it becomes a filled firm with value $J_{t+1}^{i}(x_{\max})$ and if not, it remains a vacancy.

$$V_t^i = -c_i + \beta E_t\left[q_t^i J_{t+1}^{i}(x_{\max}) + \left(1 - q_t^i\right) V_{t+1}^i\right] \tag{7}$$

We assume free entry of firms in both sectors, which in equilibrium implies that the value of posting a vacancy is equal to zero. Hence, equations (6) and (7) can be reduced to

$$c_f = \beta E_t q_t^f J_{t+1}^n(x_{\max}) \tag{8}$$

$$c_i = \beta E_t q_t^i J_{t+1}^i(x_{\max}). \tag{9}$$

The value of a filled firm is a function of the state of the worker and of the idiosyncratic productivity. Denote the value for a filled firm in the formal sector hiring a non-searching worker, in the formal sector hiring a searching worker, and in the informal sector by $J_t^n(x)$, $J_t^s(x)$ and $J_t^i(x)$ respectively.

A formal firm with high idiosyncratic productivity, above x_t^s, produces $A_t^f x$ and pays wage $w_t^n(x)$. The following period a new idiosyncratic productivity is drawn. If the new productivity level is above the search threshold, the firm obtains the value of a being filled with a non-searching worker. If the productivity is between the destruction and searching thresholds, it obtains the value of a filled formal firm hiring a searching worker. Finally, the match is dissolved if the productivity is below the destruction threshold and the firms incurs in the firing cost, F, and obtains the value of being a vacancy.

$$J_t^n(x) = A_t^f x - w_t^n(x) + \beta E_t \left[\int_{\bar{x}_{t+1}^f}^{x_{t+1}^s} J_{t+1}^s(s)\, dG(s) + \int_{x_{t+1}^s}^{x_{\max}} J_{t+1}^n(s)\, dG(s) + G\left(\bar{x}_{t+1}^f\right)\left(V_{t+1}^f - F\right) \right]. \tag{10}$$

When a formal firm with idiosyncratic productivity $x \leq x_t^s$ hires a worker, it produces $A_t^f x$ and pays wage $w_t^s(x)$. Formal jobs with low productivity are subject to destruction if the worker finds

another employment opportunity. Since the firm does not choose the productivity of the match, there is nothing it can do to keep the worker. If the worker leaves for a better job, the firm position becomes vacant, which in equilibrium has value zero and does not pay the firing cost. If the worker does not match with a new vacancy, the following period the firm will obtain the same value as the continuation value of a formal firm who hired a non-searching worker.

$$\begin{aligned} J_t^s(x) &= A_t^f x - w_t^s(x) + \beta E_t\left(p_t^f + \left(1-p_t^f\right)p_t^i\right)V_{t+1}^f \\ &+\beta E_t\left(1-p_t^f\right)\left(1-p_t^i\right)\left[\int_{\bar{x}_{t+1}^f}^{x_{t+1}^s} J_{t+1}^s(s)\,dG(s) + \int_{x_{t+1}^s}^{x_{\max}} J_{t+1}^n(s)\,dG(s) + G\left(\bar{x}_{t+1}^f\right)\left(V_{t+1}^f - F\right)\right]. \end{aligned} \tag{11}$$

An informal firm with idiosyncratic productivity x produces output $A_t^i x$ and pays a wage $w_t^i(x)$. Informal workers search for new job opportunities and hence there is a probability that the employee leaves the firms at the end of the period, leaving the position vacant. If the worker does not leave and the idiosyncratic productivity next period is high enough it continues producing.

$$\begin{aligned} J_t^i(x) &= A_t^i x - w_t^i(x) + \beta E_t\left(p_t^f + \left(1-p_t^f\right)p_t^i\right)V_{t+1}^i \\ &+\beta E_t\left(1-p_t^f\right)\left(1-p_t^i\right)\left[\int_{\bar{x}_{t+1}^i}^{x_{\max}} J_{t+1}^i(s)\,dG(s) + \left(1-G\left(\bar{x}_{t+1}^i\right)\right)V_{t+1}^i\right]. \end{aligned} \tag{12}$$

3.3 Surplus

When a firm and a worker engage in an employment relationship, the match creates a surplus which is shared between them. This surplus is defined as the sum of the values of a filled job for a firm and a worker minus their outside options, which are the value of a vacancy and the value of unemployment respectively. Since there is free entry of firms, the expression for the surplus is $S_t^f(x) = J_t^f(x) + F + W_t^f(x) - U_t$. for $f \in \{n, s\}$ and $S_t^i(x) = J_t^i(x) + W_t^i(x) - U_t$. . The surplus is

shared according to the rule derived optimally as the Nash solution to a bargaining problem. Such solution implies that both parties obtain constant fraction of the surplus equal to their bargaining power. The introduction of the taxation on labor income of formal workers implies that the share of the surplus for formal worker is lower than in the standard model. Let β_w be the bargaining power of the worker, then $W_t^f(x) - U_t = \frac{\beta_w(1-\tau)}{1-\beta_w\tau} S_t^f(x)$, $J_t^f(x) + F = \frac{1-\beta_w}{1-\beta_w\tau} S_t^f(x)$, for $f \in \{n, s\}$, $W_t^i(x) - U_t = \beta_w S_t^i(x)$ and $J_t^i(x) = (1-\beta_w) S_t^i(x)$. Combining the previous expressions with equations (1) to (12) the surplus for each type of match can be expressed as

$$\begin{aligned} S_t^n(x) &= A_t^n x + F - \tau w_t^n(x) - z - \beta E_t \left[p_t^f \frac{\beta_w(1-\tau)}{1-\beta_w\tau} S_{t+1}^n(x_{\max}) + \left(1-p_t^f\right) p_t^i \beta_w S_{t+1}^i(x_{\max}) \right] \\ &\quad + \beta E_t \left[\int_{\bar{x}_{t+1}^f}^{x_{t+1}^s} S_{t+1}^s(s)\, dG(s) + \int_{x_{t+1}^s}^{x_{\max}} S_{t+1}^n(s)\, dG(s) \right] \end{aligned} \tag{13}$$

$$S_t^s(x) = A_t^s x + F - \tau w_t^s(x) - \sigma(x) - z + \beta E_t \left(1-p_t^f\right)\left(1-p_t^i\right) \left[\int_{\bar{x}_{t+1}^f}^{x_{t+1}^s} S_{t+1}^s(s)\, dG(s) + \int_{x_{t+1}^s}^{x_{\max}} S_{t+1}^n(s)\, dG(s) \right] \tag{14}$$

$$S_t^i(x) = A_t^i x - z + \beta E_t \left(1-p_t^f\right)\left(1-p_t^i\right) \int_{\bar{x}_{t+1}^i}^{x_{\max}} S_{t+1}^i(s)\, dG(s). \tag{15}$$

3.4 Wages

From the sharing rule stated before, we can obtain the wages of each one of the states as

$$w_t^n(x) = (1-\beta_w)\frac{z}{1-\tau} + \beta_w \left[A_t^f x + \left(1 - \beta_t\left(1-p_t^f\right)\right) F + c_f \theta_t^f + \left(1-p_t^f\right)\frac{c_i \theta_t^i}{1-\tau} \right] \tag{16}$$

where the formal non-searching worker is compensated for a fraction $(1-\beta_w)$ of its forgone flow unemployment utility, and a fraction β_w of the output of the match and a measure of the costs saved by the firm for not having to be in the search process.

$$w_t^s(x) = (1-\beta_w)\frac{\sigma(x)+z}{1-\tau} + \beta_w\left[A_t^f x + \left(1-\beta_t\left(1-p_t^f\right)\left(1-p_t^i\right)\right)F\right] \tag{17}$$

where the formal searching worker is paid a fraction $(1-\beta_w)$ of the flow unemployment utility and the cost of searching and a fraction β_w of the output of the match and a measure of the firing cost saved. Note that since the worker performs on-the-job search, he is not compensated for a fraction of the cost saved by the firm for not searching.

$$w_t^i(x) = (1-\beta_w)z + \beta_w A_t^i x \tag{18}$$

which is very similar to the wage paid to the formal searching worker, except it does not get compensated for the job search cost, since that cost is assumed to be zero for the informal worker.

3.5 Thresholds

There are three thresholds in the model. The search threshold for formal workers, x_t^s, and the destruction thresholds for formal and informal firms, $\bar{x}_t^f$ and $\bar{x}_t^i$ respectively. Each one of them are obtained in the following way.

The search threshold for formal workers is defined as the value of the idiosyncratic productivity which makes the formal worker indifferent between searching and not searching. Formally x_t^s is

such that $S_t^s\left(x_t^s\right) = S_t^n\left(x_t^s\right)$, which implies the following condition

$$\begin{aligned}\frac{\sigma(x_t^s)}{1-\tau} &= \beta_t\left(p_t^f + \left(1-p_t^f\right)p_t^i\right)F + \beta E_t\left[p_t^f\frac{\beta_w\left(1-\tau\right)}{1-\beta_w\tau}S_{t+1}^n\left(x_{\max}\right) + \left(1-p_t^f\right)p_t^i\beta_w S_{t+1}^i\left(x_{\max}\right)\right] \\ &\quad -\frac{\beta}{1-\beta_w\tau}E_t\left(p_t^f + \left(1-p_t^f\right)p_t^i\right)\left[\int_{\bar{x}_{t+1}^f}^{x_{t+1}^s} S_{t+1}^s\left(s\right)dG\left(s\right) + \int_{x_{t+1}^s}^{x_{\max}} S_{t+1}^n\left(s\right)dG\left(s\right)\right]. \qquad (19)\end{aligned}$$

Since the formal non-searching surplus is only defined for $x \geq x_t^s$, the destruction threshold in the formal sector is the one which makes the searching surplus equal to zero. Hence, $\bar{x}_t^f$ is such that $S_t^s\left(\bar{x}_t^f\right) = 0$, which implies

$$\begin{aligned}A_t^s\bar{x}_t^f - \frac{\sigma(\bar{x}_t^f)}{1-\tau} &= \frac{z}{(1-\tau)} - \left(1-\beta_t\left(1-p_t^f\right)\left(1-p_t^i\right)\right)F \\ &\quad -\frac{\beta}{1-\beta_w\tau}E_t\left(1-p_t^f\right)\left(1-p_t^i\right)\left[\int_{\bar{x}_{t+1}^f}^{x_{t+1}^s} S_{t+1}^s\left(s\right)dG\left(s\right) + \int_{x_{t+1}^s}^{x_{\max}} S_{t+1}^n\left(s\right)dG\left(s\right)\right] \qquad (20)\end{aligned}$$

The destruction threshold in the informal sector is the productivity level which drives the informal surplus to zero. Therefore, $\bar{x}_t^i$ is such that $S_t^i\left(\bar{x}_t^i\right) = 0$, which implies

$$A_t^i\bar{x}_t^i = z - \beta E_t\left(1-p_t^f\right)\left(1-p_t^i\right)\int_{\bar{x}_{t+1}^i}^{x_{\max}} S_{t+1}^i\left(s\right)dG\left(s\right). \qquad (21)$$

3.6 Flows

Given the timing of the model explained before, the equations describing the worker flows in and out of every one of the states are

$$u_t = \left(1-p_{t-1}^f\right)\left(1-p_{t-1}^i\right)u_{t-1} + G\left(\bar{x}_t^f\right)n_{t-1}^n + \left(1-p_{t-1}^f\right)\left(1-p_{t-1}^i\right)\left(G\left(\bar{x}_t^f\right)n_{t-1}^s + G\left(\bar{x}_t^i\right)n_{t-1}^i\right) \quad (22)$$

$$n_t^n = \left(1-G\left(x_t^s\right)\right)n_{t-1}^n + \left(1-p_{t-1}^f\right)\left(1-p_{t-1}^i\right)\left(1-G\left(x_t^s\right)\right)n_{t-1}^s + p_{t-1}^f\left(n_{t-1}^s + n_{t-1}^i + u_{t-1}\right) \quad (23)$$

$$n_t^s = \left(1-p_{t-1}^f\right)\left(1-p_{t-1}^i\right)\left(G\left(x_t^s\right) - G\left(\bar{x}_t^f\right)\right)n_{t-1}^s + \left(G\left(x_t^s\right) - G\left(\bar{x}_t^f\right)\right)n_{t-1}^n \quad (24)$$

$$n_t^i = \left(1-p_{t-1}^f\right)\left[1-\left(1-p_{t-1}^i\right)G\left(\bar{x}_t^i\right)\right]n_{t-1}^i + \left(1-p_{t-1}^f\right)p_{t-1}^i\left(n_{t-1}^s + u_{t-1}\right) \quad (25)$$

$$1 = u_t + n_t^s + n_t^n + n_t^i. \quad (26)$$

3.7 Equilibrium

An equilibrium in this economy is a recursive competitive equilibrium composed by the set of variables:

- Unemployment rates, employment rates and vacancies u_t, n_t^n, n_t^s, n_t^i, v_t^f, v_t^i,

- values of a match for a firm, $J_t^n(x)$, $J_t^s(x)$, $J_t^i(x)$, for a worker, $W_t^n(x)$, $W_t^s(x)$, $W_t^i(x)$, and value of unemployment, U_t,

- wages, $w_t^n(x)$, $w_t^s(x)$, $w_t^i(x)$,

- idiosyncratic productivity thresholds, x_t^s, $\bar{x}_t^f$, $\bar{x}_t^i$,

which satisfy the following conditions:

- free entry of firms, (8) to (9),

- flows in the labor market, (22) to (26),

- value functions in the problem of the firm and the worker, (1) to (12),

- Nash bargaining over the surplus to determine wages, (16) to (18) and

- threshold conditions, (19) to (21)

4 Calibration

We use Brazil as the economy against which we test the implications of the model presented above. The choice of Brazil responds to the longer sample period of its data and to the reforms that took place in 1988, which make it to test the effects of policy changes in the model.

The parameters of the model are chosen to match the long run empirical evidence in Brazil for the main variables and flows in the model, which corresponds to the steady state of the model. The facts that the calibration will match are the unemployment rate, which is 0.054, the percentage of jobs which are formal jobs, 0.59, job separation rate in the formal and informal sectors, 0.01 and 0.032 respectively. Since the model cannot match the job finding rates in both sectors, we target a job finding rate in the formal and informal sectors of 0.12 and 0.21 respectively, which are slightly above and below their data counter parts, 0.092 and 0.22.

The length of the period is one quarter. The discount factor,β, is set to 0.98. The flow value of unemployment, z, which can be interpreted as the value of leisure, home production and unemployment benefits, is assumed to be one third of the productivity in the formal sector and set to 1. Changing this parameters does not alter the cross-correlation results of the model and varies only slightly the volatilities of the variables. The search cost is assumed to be linear in the idiosyncratic productivity, $\sigma(x) = \sigma_s x$, and σ_s is calibrated jointly with other parameters and takes the value $\sigma_s = 0.3$. The cost of posting vacancies in each sector is calibrated endogenously in the model and

the result is that posting a vacancy in the informal sector costs 95 percent what it costs to post it in the formal sector. c_f and c_i are set to 0.043 and 0.041 respectively.

The labor tax rate is set to 20 percent, which is a midpoint in Brazilian income taxes that range from 15 to 27.5 percent, as reported by the Brazilian Ministry of Finance. Firing costs are assumed to be 20 percent to the aggregate productivity of the formal sector, as is se to $F = 0.2$. Both the labor income tax rate and the firing cost are changed in Section 6, where we study their effects in the equilibrium of the model.

The matching function is assumed to be constant returns to scale and takes the form $m^k\left(s_t^k, v_t^k\right) = \mu^k\left(s_t^k\right)^\alpha\left(v_t^k\right)^{1-\alpha}$ for $k = \{f, i\}$. Following Mortensen and Pissarides (1994) we set $\alpha = 0.5$. μ^f and μ^i are jointly calibrated with other parameters and are set to 0.19 and 0.20 respectively. These values imply a steady state market tightness for both sectors of $\theta^f = 0.4$ and $\theta^i = 1.6$. Following Mortensen and Pissarides (1994), the bargaining power of the worker is set to $\beta_w = 0.5$, both in the formal and the informal sector.

The idiosyncratic productivity is assumed to be drawn from an log-normal, $g\left(x|\varphi,\sigma\right) = \frac{1}{x\sigma\sqrt{2\pi}}e^{\frac{-(\ln x-\varphi)^2}{2\sigma^2}}$, where $\sigma = 0.3$ and φ is calibrated endogenously so that 99 percent of the distribution falls below $x_{\max} = 1$, and is set to $\varphi = -0.7$.

The steady state aggregate productivity in the formal sector is set $A^k = 1$. The steady state productivity in the informal sector is calibrated endogenously within the model and set to 0.75. Outside the steady state, aggregate technology in both sectors are assumed to follow an autoregressive process of order one, $A_t^k = \left(A^k\right)^{1-\rho}\left(A_{t-1}^k\right)^\rho e^{\epsilon_t}$, where $\epsilon_t \sim N\left(0,\sigma_\epsilon\right)$ and is common to both sectors. $\rho = 0.95$. σ_ϵ is calibrated to match the standard deviation of the employment rate

in the data and set to 0.0023.

Table 3 summarizes the parameters of the model.

Table 3

5 Simulation Results

We now present the main results of the simulations of the model[4].

Table 4 shows the long run averages of the variables, along with the standard deviation and relative volatility with respect to employment over the business cycle. We can see that although the model is not able to replicate the magnitudes of the empirical volatilities, the model is successful at generating the relative magnitudes of the formal and informal flows. In particular, the volatilities of the variables lie outside the two standard errors interval around the standard deviations of the data. The model underestimates the volatility of the job finding rates and overestimates the variability of the job separation rates and the on-the-job flow rates. However, the model is able to reproduce part of the facts noted in Section 2. In particular, the model replicates the empirical finding of higher volatility of job finding rate in the formal sector compared to that of the informal sector. At the same time it also generates the higher separation rate of the informal sector compared to the formal one and the lower volatility of the formal to informal flow rate than that of the informal to formal one.

Therefore, we move to the most interesting part of the results which relate to the cross-correlations findings.

[4]The model simulations are performed using the Dynare package, version 3.05. http://www.cepremap.cnrs.fr/dynare/

Table 4

Table 5 shows the cross-correlations of the main variables and flows of the model with employment for both the Brazilian economy and for the simulations. Several things are worth noting. First, the model is able to replicate the high persistence observed in employment in the data, although it overestimates the higher order terms. Second, the model successfully replicates the signs of the correlations and whether the variable leads or lags employment in the cycle. However, one of the drawbacks of using a single shock in the model, technology shock, is that flows in the model co-move together and we find identical correlations for all the flows except for the formal to informal flow rate.

Let us study each of them in detail. The share of formality is pro-cyclical and lags employment by one period in the data. The simulation overestimates the magnitude of the correlation, but is able to produce the positive sign and also the fact that it lags employment in the cycle. The intuition for this result is that in good times more jobs are created and, since formal employment is more productive and less likely to be destroyed, this leads to an increase in the share of formality. Job finding rate in the data is pro-cyclical in both sectors, formal job finding rate is contemporaneous to employment and informal finding rate leads employment by two periods. The model is able to successfully replicate the positive correlation of employment and job creation. However, it generates creation which leads employment in both sectors. The positive correlation and lead of employment are intuitive. An increase in technology rises the profitability of matches, more vacancies are posted, increasing the probability for a worker to find a firm, but due to the search friction the flow of workers into employment is slow and takes time to affect substantially the level of

employment. In the case of the job separation rate, the correlation in the data is negative and seems to lead employment. This is again reproduced by the model, since a decrease in the probability of destroying jobs due to the higher profitability of employment relationships in expansions leads to higher employment levels.

Finally, the inter-sectorial flow rates, both from formal to informal and from informal to formal, are positively correlated with employment and lead employment by one period. As noted before, the fact that in expansions, when employment is higher and the share of formal jobs is also higher, the flows from the formal to the informal sector increase is a very interesting finding, since it implies that even when things are good there are formal workers who are willing to move to the informal sector, which is not something that would happen if the informal sector was this bad option which some strand of the literature has emphasized. The model is able to generate this positive correlation of employment with the formal-to-informal flow due to the fact that informal jobs, while being less productive on average than formal jobs, are better at the starting point and, since workers can still do on-the-job search from the informal sector, it is worth for them to take a job in the informal sector rather than to wait to see what the productivity of the current match is the following period, which if it is too low could imply the loss of the job.

Table 5

6 Policy Changes

The previous section studied the basic behavior of the model and how it compares with the empirical evidence shown in Section 2. Now we analyze the effects of policy changes in the equilibrium of the

model. We will study the effects of changes in firing costs, labor income taxes and vacancy posting costs, since those are the three policy elements in the model which differentiate the formal from the informal market.

The changes in labor legislation in Brazil in 1988 are a good benchmark to analyze the policy implications of our model. Overall, the generalized increase in labor cost and reduction in employer flexibly led to major changes in the allocation of workers from the formal to the informal sector. Here we explore what would be the likely impact in the main variables of the labor market if policy makers tried to undo some of these changes, moving towards a more flexible labor market. The experiments consist on decreasing firing costs, payroll taxes and costs to posting vacancies in the formal market. Additionally, we also explore the impact of an increase in the cost of posting a vacancy in the informal sector as a proxy for higher enforcement effort from part of the government.

Table 6 shows the results of the policy experiments alongside the results from the benchmark simulation.

As we can observe in the second panel of the table, a 10 percent decrease in the firing costs, from 20 to 18 percent of the aggregate productivity of the formal sector, produces a 35 percent increase in unemployment, from 0.054 to 0.073, and increases its volatility. Reducing the firing restrictions also increases the share of formality employment, from 0.59 to 0.6. Further, the reduction in the firing cost makes formal employment even more pro-cyclical, but leaves all the other correlations almost unchanged. To better understand the increase in unemployment, we should look at what happens to the flow rates. A decrease in firing restrictions generates an increase the separation rate in the formal sector, while leaving almost unchanged the separation rate in the informal sector and the

finding rates and on-the-job flow rates. This implies that while in general reducing firing cost may have two effects, one of increasing firing, since it is less costly, and another one of increasing hiring, since eventually the match will be destroyed and a lower firing cost paid, the former effect is the most important in this case. To summarize, and looking at the inverse policy, what the model implies is that an increase in the firing restrictions generates a substantial decrease in unemployment, while not decreasing notably the share of formality.

Labor income taxes are the most effective of the policies studied. We can observe that a 10 percent reduction in the tax rate, from 0.2 to 0.18, leads to a decrease in unemployment rate, from 0.054 to 0.033, an increase in the share of formality, from 59 to 70 percent, a reduction in both their volatilities and increases the correlation of the share of formality with employment to almost 1. Taxes are a major factor why formal workers may want to move to the informal sector. Hence, a drop in the marginal tax rate makes formal jobs more attractive, reducing the flow of workers from the formal to the informal sector, while also increasing slightly the opposite flow. Job finding rates remain almost unchanged, but job separations in the formal market drop dramatically and so do their volatilities. One interesting finding of the reduction in taxes is that, due to the employment increase and the higher proportion of formal jobs, which are the ones paying taxes, total tax revenue increases by 5.1 percent. However, if the tax cut is more substantial, around a 27 percent drop from the benchmark calibration, the decrease in the marginal tax rate overpowers the increase in the tax paying base and government revenue starts decreasing. This suggests that for our calibration, there exists a Laffer curve type problem when designing the fiscal policy from the part of the government. Nonetheless, it is worth noting that at around 14.5 percent marginal

labor tax rate, the share of formal employment is close to 85 percent and the tax revenues are the same as they are at the initial 20 percent tax rate.

The third policy experiment consists on varying the cost of posting vacancies. In this case we study two different changes. Fist, we analyze the reduction in the cost of posting vacancies in the formal market, c_f. There is anecdotal evidence that legally setting up vacancies and firms in Brazil and other Latin American countries can be highly costly in terms of time and resources. Hence it will be interesting to study what happens when all the non-market restrictions are eliminated. Second, we consider the increase in the cost of posting vacancies in the informal market, c_i. This could be carried out by better monitoring of the informal sector and higher enforcement of existing regulations, which will make it more difficult and costly for informal firms to hire employees. The results of both experiments can be seen in the last two panels of Table 8. As one could imagine, decreasing formal vacancy cost or increasing that of the informal market produces an increase in the share of the formal market. However, the increase in formality is almost not noticeable in the case of the reduction in c_f and it is accompanied by significant different reaction by the other variables, specially unemployment. While reducing c_f produces an increase in unemployment, increasing c_i reduces unemployment. The intuition for this different behavior of unemployment can be found in the response of the flow variables. A decrease in c_f increases the number of vacancies in the formal sector, which increases the probability of finding job in the formal sector. However, this improvement in the re-employment opportunity makes workers more willing to quit jobs and to try to find another one, which is observed by an increase in the job separation rate in both sectors. These three elements make unemployment increase in the new steady state. Similar reasoning can

be used to understand the decrease of unemployment following an increase in c_i. After c_i increases, there is a drop in vacancies in the informal market, which reduces the probability of re-employment and leads workers to be less willing to separate from existing firms, reducing separation rates in both sectors. At the same time, there is a reallocation of workers from informal jobs, where job separation is high, into formal jobs, where job separation is low. This also contributes to lower unemployment. In the case of an increase of c_f, these induced changes in the steady state levels of the variables are accompanied in both experiments by increases in the volatility of unemployment, share of formality and informal to formal flow rate, and a reduction in the volatility and pro-cyclicality of the formal to informal flow rate. Increasing c_i reduces the volatility and cross-correlation of unemployment and share of formality, and changes the intersectoral flows volatilities and correlations in the same direction as the drop in c_f.

In summary, out of the policy experiments considered here, there are two policies which are capable of reducing the size the of the informal market, bringing it closer to the numbers in developed countries, while reducing unemployment at the same time. These are reducing labor income taxes and increasing the cost or difficulty of posting vacancies in the informal market. Reducing tax rates has the additional advantage that it increases the tax paying population and increases government tax revenues. Reducing firing costs or the cost of the vacancy posting in the formal market increase the share of the formal market, but at the expense of higher unemployment. The results of firing costs and labor income tax changes are consistent with those found by Albrecht et al. (2006).

7 Conclusions

The empirical evidence on U.S., Brazil and Mexico indicates that, on the aggregate, unemployment and worker flows have similar magnitudes and cyclical properties in these three countries. However, disaggregating the labor markets in these two Latin American countries to distinguish between the formal and informal market show that the formal sector does not behave so similar to the U.S. labor market and that part of the results are driven by the informal sector. Hence, modeling the informal labor market and specially the factors which determine its existence and attractiveness for some workers is necessary to fully understand the behavior of certain Latin American labor markets and the economy as a whole.

Latin American economies like Brazil or Mexico have over 40 percent of their active population working in jobs which are considered part of the informal sector. This informal jobs are characterized according the International Labor Organization (ILO) by the lack of benefits such as medical insurance or unemployment benefit. However, the empirical evidence for these countries on worker flows between the formal and informal sector seems to indicate that the informal sector is not such an unattractive choice for workers, even in expansions, as the segmented labor market literature argues.

In this paper we propose a model of the labor market which can account for much of the cyclical behavior of job flows observed in the data for Brazil and we perform policy experiments which help understand ways to reduce the size of the informal market. We build a two-sector search and matching model with endogenous job destruction, on-the-job search, and firing cost and labor income taxes in the formal sector. We show that properly calibrating the model to the Brazilian

economy, the model is able to replicate the signs of the cross-correlation of these variables with employment and whether they lead or lag employment over the business cycle. The intuition why the model is able to generate the most striking empirical fact, the pro-cyclicality of the formality to informality job flows, is that workers in the model can search while employed and due to taxation and the low productivity of some formal jobs it is worth for workers to move to more productive, non-tax-paying informal jobs. The model however fails to reproduce the magnitudes of the empirical volatility levels of the flows, although it reproduces well the relative magnitudes of the different flows.

The policy experiments show that a decrease in the labor income tax rate would not only increase the size of the formal sector, but also reduce unemployment. The increase in formal employment would also lead to an increase in government tax revenue due to the increase in the tax paying base as long as the tax cut is not too substantial. Increasing the cost of posting informal vacancies would also increase the formal sector and reduce unemployment, producing also an increase in tax revenues. On the other hand, a decrease in the firing costs or in the cost of posting informal vacancies would increase the share of formality, but at the cost of higher unemployment and a reduction in the government tax revenues.

There are several possible extensions which could be introduced to the model in future research to make it more realistic and better fit to the data. One important extension would be the introduction of a second source of cyclical fluctuation that would address the perfect correlation of all the flows in the model. Shocks in the style of variations in tax rates or exchange rates if the model is opened, could be good candidates. Other extensions could include the modeling of part of the

informal market as self-employed, or the introduction of a more complex business cycle framework that would include optimal decisions on consumption, investment and hours worked. This last extension would also be useful to perform welfare analysis and estimate the welfare cost of the informal labor markets in these economies.

References

[1] Albrecht, J., L. Navarro and S. Vroman (2006), The Effects of Labor Market Policies in an Economy with an Informal Sector. *IZA Discussion Paper* No. 2141.

[2] Antunes, A. R. and T. V. de V. Cavalcanti (2006), Start up costs, limited enforcement, and the hidden economy. *European Economic Review*, In Press.

[3] Boeri, T. and P. Garibaldi (2006), Shadow Sorting. *CEPR Discussion Paper* No. 5487.

[4] Bosch, M. (2005). Start up cost, Informality and Policy complementarities. *Mimeo LSE.*

[5] _____ (2006). Job Creation and Job Destruction in the Presence of Informal Labor Markets. *Mimeo LSE.*

[6] Bosch, M. and W.F. Maloney (2006), Gross Flows of Workers in the Presence of Informal Markets: Mexican Experiece 1987-2002. *Mimeo World Bank Chief Economist Office.*

[7] Bosch, M., W.F. Maloney and E. Goni (2006). Gross Flows of Workers In Brazil *World Bank Chief Economist Office.*

[8] Hall, R. (2005), Employment Fluctuations with Equilibrium Wage Stickiness. American Economic Review, 95(1), 50+65.

[9] Harris, J. R., and M. P. Todaro (1970). Migration, unemployment, and development: A two sector analysis. *American Economic Review*, 60(1), 126-142.

[10] Heckman, J. J. and C. Pages, editors (2003). Law and Employment: Lessons from Latin America and the Caribbean. *National Bureau of Economic Research,* Conference Report.

[11] S. Johnson, Kaufmann, D. and P. Zoido-Lobatón (1998): Regulatory discretion and the unofficial economy. *American Economic Review*, 88(2), pp. 387-392.

[12] Kolm, A.S. and Larsen, B. (2001) "Moral Cost, the Informal Sector and Unemployment". *Working Paper* 1-2001. Department of Economics. Compenhagen Business School.

[13] Krause, M. U. and T. A. Lubik (2006), On-the-Job Search and the Cyclical Dynamics of the Labor Market. *Mimeo.*

[14] Lewis, W. A. (1954). Economic Development with Unlimited Supplies of Labor. *Manchester School of Economic and Social Studies*, 22, 139-191.

[15] Mortensen, D. T. (1994): "The Cyclical Behavior of Job and Worker Flows". *Journal of Economic Dynamics and Control*, 18, 1121-42.

[16] Mortensen, D.T. and C.A. Pissarides (1994), Job Creation and Job Destruction in the Theory of Unemployment. *Review of Economic Studies* 61, 397-415.

[17] _____ (2003), Taxes, Subsidies and Equilibrium Labor Market Outcomes. in Designing Inclusion: Tools to Raise low-end Pay and Employment in Private Enterprise, edited by Edmund S. Phelps, Cambridge: *Cambridge University Press.*

[18] Nagypal, E. (2005) "On the extent of job-to-job transitions".*Mimeo, Northwestern University.*

[19] _____ (2006) "On-the-Job Search and the Cyclical Dynamics of the Labor Market". *Mimeo, Northwestern University.*

[20] Pissarides, C. A. (1985) Short-Run Equilibrium Dynamics of Unemployment, Vacancies, and Real Wages. *American Economic Review*, 75(4), 676 –690.

[21] _____ (1994), Search Unemployment with on the Job Search. *Review of Economic Studies*, 61, 457-476.

[22] Schneider, Friedrich (2005): Shadow Economies around the World: What do we really know?, forthcoming *European Journal of Political Economy*, 2005.

[23] Shimer, R. (2005); The Cyclical Behavior of Equilibrium Unemployment and Vacancies, *American Economic Review*, 95(1):25-49.

Appendix: Data Construction

Brazil

Data for Brazil are draw from Monthly Employment Survey (Pesquisa Mensal de Emprego, hereafter PME) that conducts monthly household interviews in 6 of the major metropolitan regions, covering 25 of the national labor market. The questionnaire is extensive in its coverage of

participation in the labor market, wages, hours worked, etc. The PME is structured so as to track each household during four consecutive months and then drop them from the sample for 8 months, after which they are reintroduced for another 4 months. The rotation procedure is such that each month one fourth of the sample is substituted by households to form a new panel. Thus, after 4 months the whole initial sample has been rotated and after 8 months a third different sample is being surveyed. After 12 months the initial sample is re-encountered. Over a period of two years, three different panels of households are surveyed, and the process starts again with three new panels.

We divide the labor force, men and women between 16 and 65 years of age, into two sectors of employment: formal and informal. While the term informal suffers from overly broad and imprecise usage we follow the definition of informality provided for the International Labor Organization (ILO) for Latin American countries. This definition considers informal workers those self-employed, excluding technicians and professionals, and workers who do not have social security or medical benefits and are therefore not protected. Formal salaried workers are defined as those enjoying labor protections. Unlike other countries Brazil has fairly straight way of defining those unprotected workers. Protected formal workers are in possession of a carteira or working card which grants them such benefits as medical insurance and unemployment benefits, among others. Those without carteira are considered informal. There is a specific question in the survey that asks about the possession of a carteira during the period of work. Therefore in our definition of informality we include those self-employed (excluding technicians and professionals) and workers without working cards. We compute the quarterly averaged monthly transitions from the first quarter of 1983 to

the last quarter of 2001. We adjust for seasonality by using a moving average to mean ratio and we detrend the series using the HP filter with smoothing parameter 1600.

Mexico

Data for Mexico are drawn from the National Urban Employment Survey (ENEU) that conducts quarterly household interviews in the 16 major metropolitan areas. The questionnaire is extensive in its coverage of participation in the labor market, wages, hours worked, etc. that are traditionally found in such employment surveys. The ENEU is structured so as to track a fifth of each sample across a five quarter period. We have concatenated panels from the first quarter of 1987 to the fourth quarter of 2004.

The ENEU 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 introduced and throughout the following years additional cities were included in the sample to reach 44 at the beginning of 1998. The sample is constraint to the original 16 cities although all results are similar with extended the sample.

We broadly follow the ILO definition of informality by dividing employed workers into two sectors: formal and informal workers,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 those self-employed and owners of micro firms (less than 6 employees) with no social security contributions, excluding professionals and technicians. Owners of medium or big firms (more than 5 employees) and those professionals and technicians

self-employed or with social security contributions are all considered formal.

United States

This data was constructed by Robert Shimer. For additional details, please see Shimer (2005) and his webpage http://home.uchicago.edu/~shimer/data/flows/.

Computation of Empirical Transition Probabilities.

We assume a homogenous Markov process $X(t)$ defined over a discrete state-space $E = \{1, \ldots .K\}$ where K is the number of possible states (job sectors) a worker could be found in. We define 3 employment status. Unemployment, informal employment and formal employment. Since the data are tabulated at discrete points in time we can compute the probability $p_{ij}(t, t+n) = \Pr(X(t+n) = j, X(t) = i)$.The interpretation of p_{ij} is simply, the probability of moving from state i to state j in one step (n). Discrete time probabilities are straight forward to compute as the maximum likelihood estimator for p_{ij} is $p_{ij} = \frac{n_{ij}}{n_i}$ being n_{ij} the total number of transitions from state i to state j and n_i the total number of observations initially in state i. Data in Mexico refers to quarterly transitions whereas in Brazil is the monthly transitions quarterly averaged. We smooth the series using a moving average with a window of three quarters.

Table 1: Employment Rate, Job Finding and Separation Rates Moments - U.S. Brazil and Mexico

	U.S.			
Variable	*Long-run Mean*	*Std Dev*	*Std(X)/Std(N)*	*Corr(Xt,Nt)*
Unemployment rate	0.060	0.0048 (0.00054)	1.00	-1.00 *(-)*
Job Finding Rate	0.38	0.030 (0.0030)	6.25	0.81 (0.18)
Job Separation Rate	0.020	0.0009 (0.000075)	0.19	-0.31 (0.11)
	Brazil			
Variable	*Long-run Mean*	*Std Dev*	*Std(X)/Std(N)*	*Corr(Xt,Nt)*
Unemployment rate	0.054	0.0063 (0.0005)	1.00	-1.00 *(-)*
Job Finding Rate	0.31	0.016 (0.0019)	2.53	0.78 (0.18)
Job Separation Rate	0.020	0.0036 (0.0004)	0.57	-0.90 (0.18)
	Mexico			
Variable	*Long-run Mean*	*Std Dev*	*Std(X)/Std(N)*	*Corr(Xt,Nt)*
Unemployment rate	0.039	0.0064 (0.0016)	1.00	-1.00 *(-)*
Job Finding Rate	0.47	0.016 (0.0032)	2.50	0.69 (0.34)
Job Separation Rate	0.019	0.0034 (0.0010)	0.53	-0.91 (0.50)

Notes: Data for U.S. is from the CPS as found in Rober Shimer's website (http://home.uchicago.edu/~shimer/data/flows) and the sample period is from 1983:q1-2004:q4. Data for Brazil is from the PME (Monthly Employment Survey) and the sample period is from 1983:q1-2001:q4. Data for Mexico is from ENEU (National Urban Employment Survey) and the sample period is from 1987:q1-2004:q4. Except for the calculation of the long-run mean, all data has been seasonally adjusted and HP filtered with smoothing parameter 1600. Standard errors shown in parenthesis.

Table 2: Long Run Mean and Cyclical Volatilities - Brazil and Mexico

	Brazil			
Variable	*Long-run Mean*	*Std. Dev.*	*Std(X)/Std(N)*	*Corr(Xt,Nt)*
Unemployment Rate	0.054	0.0063 (0.00054)	1.00	-1.00 (-)
Share of Formality	0.59	0.0069 (0.0012)	1.10	0.59 (0.21)
Job Finding Rate Formal	0.092	0.0123 (0.0017)	1.96	0.81 (0.21)
Job Finding Rate Informal	0.219	0.0077 (0.0011)	1.23	0.31 (0.19)
Job Separation Rate Formal	0.010	0.0009 (0.00010)	0.14	-0.31 (0.16)
Job Separation Rate Informal	0.032	0.0074 (0.0010)	1.18	-0.89 (0.19)
Formal to Informal Flow Rate	0.053	0.0024 (0.00032)	0.39	0.46 (0.16)
Informal to Formal Flow Rate	0.086	0.0048 (0.00060)	0.77	0.67 (0.17)
Employment Rate	0.946	0.0063 (0.00054)	1.00	1.00 (-)
Formal Employment Rate	0.56	0.0093 (0.0014)	1.48	0.59 (0.21)
	Mexico			
Variable	*Long-run Mean*	*Std. Dev.*	*Std(X)/Std(N)*	*Corr(Xt,Nt)*
Unemployment Rate	0.039	0.0064 (0.0016)	1.00	-1.00 (-)
Share of Formality	0.580	0.0087 0.0011	1.36	0.62 0.331
Job Finding Rate Formal	0.21	0.015 (0.0025)	2.42	0.86 (0.404)
Job Finding Rate Informal	0.26	0.0094 (0.0010)	1.47	-0.24 (0.200)
Job Separation Rate Formal	0.014	0.0018 (0.00045)	0.28	-0.75 (0.413)
Job Separation Rate Informal	0.022	0.0042 (0.0012)	0.65	-0.93 (0.508)
Formal to Informal Flow Rate	0.12	0.0030 (0.00054)	0.48	0.01 (0.154)
Informal to Formal Flow Rate	0.17	0.0053 (0.00090)	0.84	0.81 (0.399)
Employment Rate	0.961	0.0064 (0.0016)	1.00	1.00 (-)
Formal Employment Rate	0.558	0.0109 0.0019	1.71	0.80 0.413

Notes: Data for Brazil is from the PME (Monthly Employment Survey) and the sample period is from 1983:q1-2001:q4. Data for Mexico is from ENEU (National Urban Employment Survey) and the sample period is from 1987:q1-2004:q4. Except for the calculation of the long-run mean, all data has been seasonally adjusted and HP filtered with smoothing parameter 1600. Standard errors shown in parenthesis.

Table 3: Model Parameters - Brazil Calibration

Exogenous parameters	
β= 0.98	z= 0.33
β_w= 0.50	Af= 1.00
α= 0.50	ρ= 0.95
τ= 0.20	F= 0.20
σ= 0.20	xmax= 1.00
Endogenous parameters	
c_f= 0.043	σ_s= 0.30
c_i= 0.041	φ= -0.70
μ_f= 0.19	Ai= 0.75
μ_i= 0.20	σ_ε= 0.01

Table 4: Long Run Mean and Cyclical Volatilities - Brazil

	Data			***Model Simulation***		
Variable	*Long-run Mean*	*Std. Dev.*	*Std(X)/Std(N)*	*Long-run Mean*	*Std. Dev.*	*Std(X)/Std(N)*
Unemployment Rate	0.054	0.0063 (0.00054)	1.00	0.054	0.0063	1.00
Share of Formality	0.59	0.0069 (0.0012)	1.10	0.59	0.0017	0.26
Job Finding Rate Formal	0.092	0.012 (0.0017)	1.96	0.12	0.0039	0.62
Job Finding Rate Informal	0.22	0.0077 (0.0011)	1.23	0.21	0.0016	0.26
Job Separation Rate Formal	0.010	0.0009 (0.00010)	0.14	0.010	0.0026	0.41
Job Separation Rate Informal	0.032	0.0074 (0.0010)	1.18	0.032	0.0032	0.51
Formal to Informal Flow Rate	0.053	0.0024 (0.00032)	0.39	0.085	0.0027	0.42
Informal to Formal Flow Rate	0.086	0.0048 (0.00060)	0.77	0.120	0.0039	0.62
Employment Rate	0.946	0.0063 (0.00054)	1.00	0.946	0.0063	1.00
Formal Employment Rate	0.56	0.0093 (0.0014)	1.48	0.56	0.0047	0.75

Notes: Data for Brazil is from the PME (Monthly Employment Survey) and the sample period is from 1983:q1-2001:q4. Except for the calculation of the long-run mean, all data has been seasonally adjusted and HP filtered with smoothing parameter 1600. Model simulations results are theoretical moments, HP filtered with smooting parameter 1600. Standard errors shown in parenthesis. Simulations are performed using the Dynare package, version 3.05. http://www.cepremap.cnrs.fr/dynare/

Table 5: Cross-Correlations with Employment Rate - Brazil

	Data										
Variable	*Corr(X_t,N_{t-5})*	*Corr(X_t,N_{t-4})*	*Corr(X_t,N_{t-3})*	*Corr(X_t,N_{t-2})*	*Corr(X_t,N_{t-1})*	*Corr(X_t,N_t)*	*Corr(X_t,N_{t+1})*	*Corr(X_t,N_{t+2})*	*Corr(X_t,N_{t+3})*	*Corr(X_t,N_{t+4})*	*Corr(X_t,N_{t+5})*
Unemployment Rate	0.083	-0.061	-0.300	-0.593	-0.872	-1.000	-0.872	-0.593	-0.300	-0.061	0.083
	(0.14)	*(0.12)*	*(0.11)*	*(0.13)*	*(0.16)*	*(-)*	*(0.16)*	*(0.13)*	*(0.11)*	*(0.12)*	*(0.14)*
Share of Formality	-0.04	0.12	0.33	0.54	0.65	0.59	0.37	0.15	-0.01	-0.14	-0.21
	(0.11)	*(0.13)*	*(0.17)*	*(0.21)*	*(0.23)*	*(0.21)*	*(0.18)*	*(0.14)*	*(0.12)*	*(0.14)*	*(0.17)*
Job Finding Rate Formal	*0.16*	*0.27*	*0.42*	*0.58*	*0.73*	*0.81*	*0.72*	*0.45*	*0.14*	*-0.078*	*-0.21*
	(0.11)	*(0.13)*	*(0.16)*	*(0.19)*	*(0.21)*	*(0.21)*	*(0.19)*	*(0.14)*	*(0.11)*	*(0.11)*	*(0.12)*
Job Finding Rate Informal	*0.03*	*-0.02*	*-0.01*	*0.07*	*0.16*	*0.31*	*0.49*	*0.51*	*0.39*	*0.26*	*0.17*
	(0.16)	*(0.16)*	*(0.15)*	*(0.14)*	*(0.16)*	*(0.19)*	*(0.21)*	*(0.18)*	*(0.14)*	*(0.12)*	*(0.12)*
Job Separation Rate Formal	0.48	0.40	0.26	0.092	-0.11	-0.31	-0.43	-0.43	-0.42	-0.37	-0.25
	(0.17)	*(0.16)*	*(0.14)*	*(0.16)*	*(0.17)*	*(0.16)*	*(0.14)*	*(0.11)*	*(0.12)*	*(0.16)*	*(0.19)*
Job Separation Rate Informal	*0.16*	*0.01*	*-0.21*	*-0.47*	*-0.73*	*-0.89*	*-0.85*	*-0.68*	*-0.45*	*-0.20*	*0.01*
	(0.16)	*(0.13)*	*(0.12)*	*(0.14)*	*(0.17)*	*(0.19)*	*(0.19)*	*(0.17)*	*(0.14)*	*(0.13)*	*(0.15)*
Formal to Informal Flow Rate	*-0.01*	*0.02*	*0.15*	*0.37*	*0.57*	*0.67*	*0.67*	*0.51*	*0.28*	*0.12*	*0.11*
	(0.12)	*(0.13)*	*(0.14)*	*(0.13)*	*(0.15)*	*(0.17)*	*(0.18)*	*(0.17)*	*(0.16)*	*(0.14)*	*(0.14)*
Informal to Formal Flow Rate	0.02	-0.04	0.03	0.21	0.38	0.46	0.50	0.40	0.21	0.10	0.16
	(0.12)	*(0.13)*	*(0.15)*	*(0.16)*	*(0.17)*	*(0.16)*	*(0.15)*	*(0.16)*	*(0.17)*	*(0.16)*	*(0.13)*
	Model Simulation										
Variable	*Corr(X_t,N_{t-5})*	*Corr(X_t,N_{t-4})*	*Corr(X_t,N_{t-3})*	*Corr(X_t,N_{t-2})*	*Corr(X_t,N_{t-1})*	*Corr(X_t,N_t)*	*Corr(X_t,N_{t+1})*	*Corr(X_t,N_{t+2})*	*Corr(X_t,N_{t+3})*	*Corr(X_t,N_{t+4})*	*Corr(X_t,N_{t+5})*
Unemployment Rate	-0.13	-0.33	-0.54	-0.75	-0.92	-1.00	-0.92	-0.75	-0.54	-0.33	-0.13
Share of Formality	0.81	0.92	0.96	0.91	0.74	0.51	0.28	0.07	-0.10	-0.24	-0.34
Job Finding Rate Formal	-0.19	-0.08	0.071	0.26	0.50	0.80	0.89	0.83	0.69	0.51	0.34
Job Finding Rate Informal	-0.19	-0.08	0.071	0.26	0.50	0.80	0.89	0.83	0.69	0.51	0.34
Job Separation Rate Formal	0.19	0.08	-0.07	-0.26	-0.50	-0.80	-0.89	-0.83	-0.69	-0.51	-0.34
Job Separation Rate Informal	0.19	0.078	-0.071	-0.26	-0.50	-0.80	-0.89	-0.83	-0.69	-0.51	-0.34
Formal to Informal Flow Rate	-0.16	-0.059	0.076	0.25	0.45	0.76	0.86	0.81	0.67	0.51	0.33
Informal to Formal Flow Rate	-0.19	-0.078	0.071	0.26	0.50	0.80	0.89	0.83	0.69	0.51	0.34

Notes: Data for Brazil is from the PME (Monthly Employment Survey) and the sample period is from 1983:q1-2001:q4. All data has been seasonally adjusted and HP filtered with smoothing parameter 1600. Model simulations results are theoretical moments, HP filtered with smooting parameter 1600. Standard errors shown in parenthesis. Simulations are performed using the Dynare package, version 3.05. http://www.cepremap.cnrs.fr/dynare/

Table 6: Policy Experiments

	Long-run Mean	Std. Dev.	Std(X)/Std(N)	Corr(X_t,N_t)
Benchmark Simulation				
Unemployment Rate	0.054	0.0063	1.00	-1.00
Share of Formality	0.59	0.0017	0.26	0.51
Job Finding Rate Formal	0.12	0.0039	0.62	0.80
Job Finding Rate Informal	0.21	0.0016	0.26	0.80
Job Separation Rate Formal	0.010	0.0026	0.41	-0.80
Job Separation Rate Informal	0.032	0.0032	0.51	-0.80
Formal to Informal Flow Rate	0.085	0.0039	0.62	0.80
Informal to Formal Flow Rate	0.12	0.0027	0.42	0.76
10% Decrease in Firing Costs				
	Long-run Mean	*Std. Dev.*	*Std(X)/Std(N)*	*Corr(X_t,N_t)*
Unemployment Rate	0.073	0.0087	1.00	-1.00
Share of Formality	0.60	0.0025	0.29	0.73
Job Finding Rate Formal	0.13	0.0039	0.45	0.81
Job Finding Rate Informal	0.21	0.0016	0.18	0.81
Job Separation Rate Formal	0.022	0.0046	0.53	-0.81
Job Separation Rate Informal	0.034	0.0033	0.38	-0.81
Formal to Informal Flow Rate	0.082	0.0029	0.33	0.79
Informal to Formal Flow Rate	0.13	0.0039	0.45	0.81
10% Decrease in the Tax Rate				
	Long-run Mean	*Std. Dev.*	*Std(X)/Std(N)*	*Corr(X_t,N_t)*
Unemployment Rate	0.033	0.0029	1.00	-1.00
Share of Formality	0.70	0.0021	0.72	-0.99
Job Finding Rate Formal	0.14	0.0037	1.28	0.82
Job Finding Rate Informal	0.21	0.0016	0.55	0.82
Job Separation Rate Formal	0.0011	0.0004	0.14	-0.82
Job Separation Rate Informal	0.037	0.0035	1.21	-0.82
Formal to Informal Flow Rate	0.067	0.0022	0.76	0.77
Informal to Formal Flow Rate	0.14	0.0037	1.28	0.82
Decrease in the Formal Vacancy Cost to the Level of the Informal Sector				
	Long-run Mean	*Std. Dev.*	*Std(X)/Std(N)*	*Corr(X_t,N_t)*
Unemployment Rate	0.056	0.0064	1.00	1.00
Share of Formality	0.594	0.0018	0.28	0.57
Job Finding Rate Formal	0.12	0.0041	0.64	0.80
Job Finding Rate Informal	0.21	0.0015	0.23	0.80
Job Separation Rate Formal	0.011	0.0027	0.42	-0.80
Job Separation Rate Informal	0.033	0.0032	0.50	-0.80
Formal to Informal Flow Rate	0.087	0.0027	0.42	0.76
Informal to Formal Flow Rate	0.12	0.0041	0.64	0.80
Increase in the Informal Vacancy Cost to the Level of the Formal Sector				
	Long-run Mean	*Std. Dev.*	*Std(X)/Std(N)*	*Corr(X_t,N_t)*
Unemployment Rate	0.048	0.0059	1.00	1.00
Share of Formality	0.62	0.0013	0.22	0.27
Job Finding Rate Formal	0.12	0.0039	0.66	0.80
Job Finding Rate Informal	0.20	0.0015	0.25	-0.80
Job Separation Rate Formal	0.009	0.0023	0.39	-0.80
Job Separation Rate Informal	0.029	0.0031	0.53	-0.80
Formal to Informal Flow Rate	0.076	0.0026	0.44	0.76
Informal to Formal Flow Rate	0.12	0.0039	0.66	0.80

Notes: Model simulations results are theoretical moments, HP filtered with smooting parameter 1600. Simulations are performed using the Dynare package, version 3.05. http://www.cepremap.cnrs.fr/dynare/