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Informal and Formal Labour Flexibility in Mexico*

Flexibilidad laboral en los sectores formal e informal de México

Carlo Alcaraz**

Abstract

We address a vital topic about labour markets in developing countries: The flexibility of the formal and informal labour sectors. For the Mexican economy, we use a panel from the National Survey of Urban Employment (ENEU) from 1995 to 2001. We control for workers' observable characteristics, sample selection and non observable regional heterogeneity. We also take into account the possible endogeneity of the unemployment rate. The results show evidence that in the formal sector, unemployment does not affect wages. On the contrary, we found a clear negative effect of unemployment on wages in the informal sector. We also found evidence of a positive relation between formal-informal wage differential and unemployment. These results suggest that the informal sector is more flexible than the formal sector.

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Key words: informal sector, labor flexibility, sample selection, endogeneity.

JEL Classification: J60, O17.

Resumen

En este trabajo estudiamos un tema de vital importancia para los mercados laborales en países en desarrollo: La flexibilidad laboral en el sector formal e informal de la economía. Para el caso de la economía mexicana, usamos datos tipo panel de la Encuesta Nacional de Empleo Urbano (ENEU) de 1995 a 2001. Controlamos por características observables de los trabajadores y heterogeneidad no observada entre regiones. También consideramos la posible endogeneidad de la tasa de desempleo. Los resultados muestran evidencia de que en el sector formal, la tasa de desempleo no afecta los salarios. Por el contrario, encontramos un fuerte efecto negativo de la tasa de desempleo sobre los salarios del sector informal. También encontramos evidencia de una relación positiva entre diferenciales salariales entre el sector formal y el informal y la tasa de desempleo. Estos resultados sugieren que el sector informal es más flexible que el sector formal en el mercado laboral mexicano.

Palabras clave: sector informal, flexibilidad laboral, selección muestral, endogeneidad.

Clasificación JEL: J60, O17.

Introduction

In this study, we address a vital topic about labour markets in developing countries: The flexibility of the formal and informal labour sectors.

In a flexible labour market¹, wages react downwards quickly after a shock in the demand for labour. Since wages are an important com-

¹ There are two types of flexibility: flexibility in employment (external flexibility) and flexibility in work (internal flexibility). In this paper we deal with external flexibility: in a period of economic disequilibrium the labour market adapts to the new circumstances

ponent of the inflationary process, a swift reaction in wages during an economic crisis will have two positive effects on the economy: first, the inflationary pressure will be reduced, and, second, the impact of the shock on unemployment will be lower.

Generally, researchers and the government use information about wages in the formal economy. Given that nearly 40% of the Mexican labour force is informal² (Mexican Survey of Urban Employment (ENEU)), it is crucial to include and understand this sector, in order to understand the dynamics of the labour markets in developing countries.

In this paper, we empirically investigate differences in flexibility between the formal and the informal market. We expect to find that the informal labour market is more flexible than the formal one. As the following section will show, there is more than one possible theoretical explanation for this fact. The most traditional one is that regulatory mechanisms imposed by a legal framework create restrictions on firing, hiring and promoting workers, and hence adversely affect flexibility in the formal labour market; whereas the absence of such regulatory and legal restrictions would promote the informal market's flexibility. The labour literature suggests alternative explanations of differentiated labour market flexibilities. The efficiency wages literature explains differentials in flexibility between the two sectors by assuming different observability of the workers' effort. Job-search theory can also elucidate differentials in flexibility by reference to differentials in information between the two sectors.

There are many ways to measure labour market flexibility. In the labour literature, there are three types of wage flexibility: relative wage flexibility allows a smooth transfer of labour out of contracting industries

through flexibility in employment. This is achieved through a combination of adjustments in wages, and in the demand and supply of labour. Flexibility is characterized by the rapid relocation of labour between industries, occupations or regions, and it ensures that any disturbance to the labour market is short-lived.

² In the case of employees, informal workers are those who do not have either of the following benefits: Social Security (IMSS), Public Social Security (ISSSTE), Pensions (AFORE), private health care (provided by the employer) or registration to the National Institute of House Founding (INFONAVIT). In the case of the self employed, workers not registered with a local or federal government or in commercial association are considered to be informal.

or regions and into expanding ones; real wage flexibility determines the overall balance of supply and demand in the labour market; and finally, nominal wage rigidities reflect the difficulties of downward nominal wage flexibility. Unlike traditional studies of labour market flexibility, this analysis includes differences in labour flexibilities across regions and uses real wage series, therefore it is related to real and relative wage rigidities.

We analyze how wages react to changes in unemployment in the formal and in the informal sector. We also estimate how unemployment affects formal-informal wage differentials. If wage differentials are considered as a form of labour market distortion³, quantifying the effect of unemployment on wage differentials can shed light on the magnitude of the problem the Mexican labour market is facing.

We sequentially try different specifications in order to test the robustness of the results. We start using raw wages, we then use wages estimated by controlling for observable characteristics, sample selection and, finally, we also control for endogeneity of the unemployment rate.

We found that, if the unemployment rate increases by 10%, informal wages decrease by 27%. On the other hand, we have not found a statistical effect of unemployment on formal wages. This could be seen as evidence that the informal labour market is more flexible than the formal one. Regarding wage differentials, we found that if unemployment increases by 10%, formal-informal wage differentials increase by 24%. It is important to underline that these wage differentials are estimated after controlling for a wide range of workers' observable characteristics, sample selection and unobserved regional heterogeneity. Therefore, wage differentials may be considered as an indicator of labour market efficiency. In this context, we show evidence that during an economic crisis i.e. volatile unemployment, like the one Latin American countries

³ Several studies on informal labour market have estimated formal-informal labour wage differentials (Alcaraz, Chiquiar and Ramos Francia, 2008; Perry, Maloney, Arias, Fajnzylber, Mason and Saavedra 2007; Maloney, 1999; Gong and Van Soest, 2002 among others). The majority of these papers found that, after controlling for diverse workers' characteristics, formal workers' wages are higher than those of informal workers. However, Maloney (1999) and Maloney (2004) argue that informal workers may be willing to receive lower wages due to non-pecuniary advantages of being employed in the informal sector, e.g. flexible working hours.

are facing since the end of 2008, the efficiency of labour markets diminishes further making more difficult for the economy to adapt to the new circumstances and delaying the recovery process.

We could not find any reference in the consulted literature regarding the relationship between wages in the formal and informal sectors and unemployment. However Neri (2002), on his results for the informal sector in Brazil, estimated wage curves for formal and informal workers separately. He found that the elasticity of formal wages with respect to unemployment is negative and lower in absolute value than the elasticity of the informal workers wage. This finding goes in line to what we have found: that wages of informal workers are more sensitive to changes in unemployment than formal workers' wages.

The outline of this paper is as follows. In Section I, we review theoretical approaches that can explain the behavior of different sectors in a single labour market. In Section II, we review the definition of the informal labour market. Section III describes the methodology, while Section IV shows wage estimations. Section V presents the first results, and Section VI shows estimations that control for the endogeneity of the unemployment rate. Finally, Section VII contains concluding remarks.

I. Theoretical Background

Given the characteristics of the informal labour market, we expect to find that the informal labour market is more flexible than the formal one. There are different ways to explain this phenomenon.

The lack of regulations in the informal sector is the most obvious way to explain its flexibility. In Mexico, the salaried work regulated by the Federal Law of Labour, which tries to promote safe work conditions, regulates labour contracts, minimum wages, employee benefits and union activity. For instance, Article 23 of the Federal Law of Labor (LFT⁴) establishes that workers who have worked in a firm for more than one year are entitled to receive a dismissal pay equal to three

⁴ Spanish acronym.

month wages if fired. Since the informal sector does not comply with the LFT, the complete absence of a labour legal framework simplifies firing workers. The process of hiring a worker is also easier in the informal sector, since they avoid to comply with the set of bureaucratic requirements normally needed in the formal sector, such as registering the worker with Social Security and the Ministry of Finance.

The absence of union activity in the informal sector is also an important factor in its flexibility. The process of hiring a worker is usually even more difficult if a firm has an unionized work force, because unions place important restrictions on the entrance of new workers. Additionally, it is also more difficult to fire an unionized worker, and the union acts as a strong pressure group when negotiating new wage rates.

Besides this more traditional explanation, which emphasizes differences in regulatory rigidities, there are other ways of explaining the differences in wage flexibility between formal and informal labour market. In fact, these differences can be explained without the assumption that regulations affect both sectors differently.

Esfahani and Salehi-Isfahani (1989) link effort observability with informality in a theoretical model, using efficiency wages theory. According to the authors, the main characteristics of the informal sector (small firm sizes, low skilled workers and low technological level) are associated with higher levels of effort observability and more competitive wages, which imply no involuntary unemployment and more flexibility. In contrast, in the formal sector with lower levels of effort observability, wages are usually above the reservation wage level, and this promotes involuntary unemployment and less labour flexibility.

Regarding job search, theoretical models of job search generally contain only one parameter capturing all possible factors affecting the efficiency of search. However, Woltermann (2002) argues that, in most countries, the labour market is segmented into formal and informal employment and self-employment. In this model, vacancies in these different labour market sectors are promoted via different channels, and part of the labour market segmentation originates from a lack of information on vacancies in the formal sector. The lack of information in the formal sector makes it more rigid, so wages take more time to react to shocks in the economy.

II. Definition and identification of informality

A. Definition

Informal employment produces legal goods but it does not comply with governmental regulations. This general definition of informality is very convenient, for two reasons. The first is that it differentiates the illegal sector from informal work, and thus excludes drug dealing, robbery and corruption from informal employment. The second reason is that it links informal work with governmental regulations and not with a particular labour characteristics i.e. firm size, wage, etc.

B. The data and identification of informal employment

Information about wages in Mexico comes primarily from three sources: contractual wages (Ministry of Labour), wages from workers registered in the Mexican Institute of Social Security (IMSS), and wages in the manufacturing sector (National Institute of Statistics and Geography, INEGI). These wage indicators have two main advantages: periodicity and opportunity. However, this information covers only a limited part of the Mexican labour market. This portion of the sector is generally known as formal employment.

To identify the informal sector, we use the National Survey of Urban Employment (ENEU). In this work we use individual level data covering urban areas. It surveys around 100,000 workers in every Mexican state on a quarterly basis collecting information from households. It was designed to be representative of urban areas at national level. In 1995 the Mexican economy endured a serious crisis in which it experienced significant changes in unemployment and wages. This variation in time allows us to identify the effects we are interested in. It must be mentioned that in the second quarter of 2000, the ENEU was replaced with the Quarterly National Survey of Employment (Spanish acronym ENE). The ENE also includes rural zones, but started to lose cities sequentially since 2002. Therefore, in order to take advantage of the volatility produced by the crisis that started at the end of 1994, and to avoid losing cities from the sample, the study goes from the first quarter of 1995 to the fourth quarter of 2001.

This survey has information about workers' benefits and business registration status. Therefore, it is possible to identify informal work. Self employed workers and employees have different legal requirements. While the former are not required by law to be registered to social security, employees on the contrary, by law must to be registered to the IMSS (Ley Federal del Trabajo art. 20 and 21).

Therefore, in this paper we use two methods to identify informal workers. In the case of employees we consider informal workers those who do not have either of the following benefits: Social Security (IMSS), Public Social Security (ISSSTE), Pensions (AFORE), private health care (provided by the employer) or registration to the National Institute of House Founding (INFONAVIT). In the case of the self employed, workers registered with a local or federal government or in a commercial association are considered to be formal. In this way, we avoid that self employed workers that are registered and comply with governmental regulations to be wrongly considered informal.

This criteria to identify informal workers is different from traditional methods. These methods generally link informal labour with people working in small firms (usually workers in firms smaller than five employees are considered informal). However, a substantial amount of unregistered employees work in firms higher than 100 workers⁵. Furthermore, working in a small firm does not guarantee unregistered work, many small firms might be registered and pay taxes. Therefore, the traditional method to identify informal workers is not very accurate. Additionally, considering that the ENEU is held in households and not in firms, it is possible that individuals who respond the interview have a better knowledge about the type of benefits he or she receives and, in case of being self employed, the registration status their business may have. Consequently, we consider the that chosen criteria to identify informal workers is less prone to error than the criteria based on the size of the establishment.

⁵ If we consider the 2001 ENEU average, about 9% of the unregistered workers belong to firms of 100 or more employees.

C. Variable list

Apart from worker's age, wage and unemployment rate, all variables are dummies. We divided variables in two groups: worker's characteristics and work place characteristics. Table 1 shows the variable list.

Table 1. Variables list.

Worker characteristics	Work place characteristics
Logarithm of real monthly wage	<i>Economic sector:</i>
age	Farming and Agriculture
age2: age squared	Mining and Electricity industry
<i>Marital status:</i>	Manufacturing
Married	Construction
Single	Commerce
<i>Years of schooling:</i>	Communications and Transportation
Less than 6 years of schooling	Services
Between 6 -12 years of schooling.	Public Administration and Defense
More than 12 years of schooling	<i>Firm size:</i>
<i>Region:</i>	One person
North	Between 2 and 15 people
Center	Between 16 and 100 people
South	More than 100 people
<i>Relative:</i>	
Head of family	
Partner	
Son	
<i>Gender</i>	

In this study we use the logarithm of the real monthly wage deflated by the National Consumer Price Index (CPI) published by INEGI. We estimate the unemployment rate with data from the ENEU using the International Labour Organization (ILO) definition of unemployment: unemployed people do not have a job, want a job, have actively sought work in the last 4 weeks and are available to start working in the next 2 weeks. Those that have worked at least one hour last week (from the day of the interview) and those who are temporarily away from a job, e.g. on holiday, are considered to be employed.

III. Methodology

Empirical studies of labour market flexibility have focused on cross-country flexibility (Bertola, 1990; Lazear, 1990; among others). These researchers analyzed the relationship between labour market regulations across countries and employment indicators, e.g. unemployment rate and participation level. From the data available in the ENEU, we can identify two type of workers (formal and informal) that coexist in the same labour market. We can also obtain unemployment and wages across Mexican states and time.

First, we study the two sectors separately i.e. how unemployment affects wages in the formal and in the informal sector. Second, we study the link between formal-informal wage differentials and unemployment.

Given that the main objective of this paper is to study labour market flexibility in the formal and the informal sectors, the second estimation may seem redundant. However, wage differentials can be seen as a measure of labour market efficiency, higher wage differentials may be related to higher distortions. Studying the relationship between unemployment and wage differentials in time can help to quantify modifications in the labour market distortions when unemployment changes, a relevant information for this study.

We analyze the relationship between wages and unemployment across two dimensions: regions and time. As explained in Section I, we expect informal labour to be more flexible than formal labour.

Heterogeneity between states allows us to capture differences in wages and unemployment across regions. States with higher levels of labour market regulations enforcement⁶ may present higher wage differentials between formal and informal workers, and a higher level of unemployment. Additionally, the dynamic of changes in wages and unemployment in time provides more information. For example, during a negative shock to the economy, wages in the informal labour may

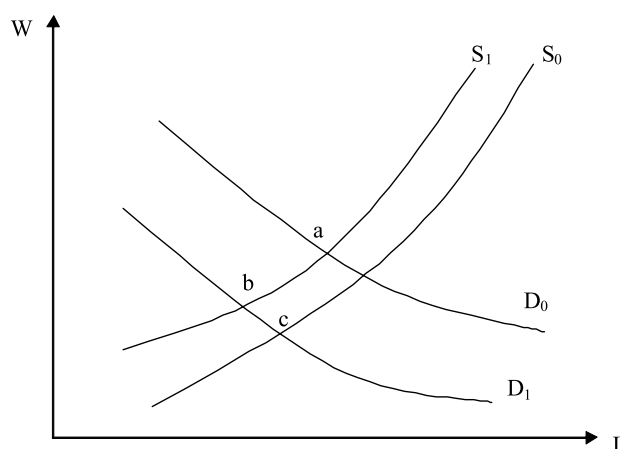
⁶ Mexico is a very heterogeneous country. Labour market regulations may be more difficult to enforce in states with higher proportion of people living in isolated regions or with higher proportion of small firms. These characteristics are more prevalent in southern states.

react downwards swiftly, and unemployment among informal workers will not increase significantly. On the other hand, formal workers may present higher degree of wage rigidities. Therefore, if there is a different level of flexibility between formal and informal labour during a negative shock to the economy, we can expect a rise in the unemployment rate, together with an increment in wage differentials between formal and informal workers. That is, a positive relationship between wage differentials and unemployment. It is important to underline that there may be other factors that can explain differentials in labour market flexibility. For instance, a negative shock to the economy might reduce the demand for labour in the construction sector while leaving the demand of labour in the government sector unchanged. Since there is higher incidence of informal labour in the construction sector, the informal wage will fall more than the formal wage, even if the government sector is perfectly flexible. However, given that sectors with higher proportion of informal workers tend to be more flexible, we consider that this issue is not too worrisome.

This study presents the following main challenges. First, the selection between formal and informal workers may not be random and, second, the possible correlation between shocks in wages and shocks in unemployment.

The first problem can cause formal - informal flexibility differentials to be the result of differences in workers' characteristics, and not of differences in regulations or in workers' effort observability between formal and informal labour. To deal with this issue, we control for workers' observable characteristics. Fortunately, the ENEU uses a wide range of questions that can give us a good idea of each workers' observable characteristics. Diverse regions may have different labour market structures, and panel data allows us to control for fixed regional specific effects, no matter whether they are observed or not. We can also control for sample selection.

Figure 1. Endogeneity of the unemployment rate.



The second problem generates endogeneity of the unemployment rate. It is worth analyzing carefully the effect of the endogeneity of the unemployment rate on the estimations. This problem may arise if there are unobserved factors that affect the unemployment rate and wages at the same time. The sign of the bias due endogeneity of the unemployment is not clear; however we illustrate a particular example of negative bias:

In the case of an economic crisis, the demand for labour shifts from D_0 to D_1 (Figure 1). If the supply of labour does not change, the new equilibrium point is c . Hence, we have a negative relationship between wage and unemployment.

However it may happen that the economic crisis also affects the supply of labour, shifting the curve from S_0 to S_1 . In this case, the new equilibrium point is b . In the new equilibrium we still have a negative relationship between wage and unemployment, but not so strong. In this case, if we do not control for the endogeneity of the unemployment rate, the results will be negatively biased.

We estimate the relationship between unemployment and wages under a number of different specifications. Comparing the results allows us

to check for robustness and to obtain a better understanding of the problem. In all the regressions, we include time dummy variables.

In order to obtain the wage differentials we do one regression per state per quarter, we have 28 quarters (from 1995 to 2001) and 32⁷ states, thus we have 881 observations. We obtain wage differentials in three different ways:

1. Raw differentials
2. Controlling for observable differences
3. Controlling for observable differences and sample selection

We then use the data obtained above to analyze the relationship between wage differentials and unemployment with two panel data models.

1. Fixed effect model
2. Dynamic Model, Arellano-Bond Generalized Method of Moments (GMM)

We now describe in detail how we estimate wages and wage differentials.

IV. Estimating wages

A. Raw wages

1. Wages

We obtain the average of the formal and informal raw wages by state and time, denoted $\overline{LogW}_{s,t}^{F,raw}$ and $\overline{LogW}_{s,t}^{I,raw}$ respectively, where t is quarter and s is the state where the worker is based. We get 881 observations for each sector wage.

⁷ Quintana Roo y Baja California Sur were incorporated to the ENEU in the first quarter of 1996. Hidalgo was incorporated in the fourth quarter of 1996. After the fourth quarter of 1996, the sample of states is complete.

2. Wage differentials

To obtain raw differentials, we regress the following equation for each worker i .

$$\text{Log}W_{i,s,t} = \alpha_{s,t} + \beta_{s,t} \text{Formal}_{i,s,t} + \varepsilon_{i,s,t} \quad (1)$$

where *Formal* is 1 if the worker is formal or 0 otherwise. *LogW* is the logarithm of the real monthly wage. $\beta_{s,t}$ represents the difference in wage associated with the fact of being formal. We can obtain the wage differentials setting $\text{draw}_{s,t} = \beta_{s,t}$ (a regression for each quarter (t) and each state (s), from each regression we obtain one β). Therefore we obtain 881 observations of $\text{draw}_{s,t}$.

B. Controlling for observable characteristics

1. Wages

In order to control for observable characteristics, we run a wage regression with personal worker characteristics, and those linked with work-related characteristics as independent variables *separately*, for formal and informal workers:

$$\text{Log}W_{i,s,t}^F = \alpha_{s,t} + \gamma_{s,t} X_{i,s,t}' + \varepsilon_{i,s,t} \text{ if } i = \text{Formal}$$

$$\text{Log}W_{i,s,t}^I = \alpha_{s,t} + \gamma_{s,t} X_{i,s,t}' + \varepsilon_{i,s,t} \text{ if } i = \text{Informal}$$

Then we obtain the average of the estimated wages by state and quarter. That is, 881 observations of each $\overline{\text{Log}\hat{W}_{s,t}^{F,cont}}$ and $\overline{\text{Log}\hat{W}_{s,t}^{I,cont}}$.

2. Wage differentials

To control for observable characteristics, we add to equation 1 workers' observable characteristics. We then run the following regression *for all* workers:

$$\text{Log}W_{i,s,t} = \alpha_{s,t} + \beta_{s,t} \text{Formal}_{i,s,t} + \gamma_{s,t} X_{i,s,t}' + \varepsilon_{i,s,t}$$

We set $\beta_{s,t} = d\text{cont}_{s,t}$ and we obtain 881 observations of $d\text{cont}_{s,t}$. The term $\gamma_{s,t}$ captures the wage differentials that can be explained by the

workers' characteristics. It is important to underline that controlling for observable characteristics does not eliminate all individual specific differences that determine wage differentials. Two individuals with the same observable characteristics in the same sector may still have different wages because they may have different abilities.

C. Controlling for observable characteristics and sample selection

The former specification had a potential problem of sample selection. When we split the sample into two sub-samples (formal and informal workers) the new sub-samples may not be random. If some workers' characteristics affect the workers' probability of being formal (or informal), the process that determines which worker is formal and which is informal (treatment) is not random, and the OLS regression will be biased.

A solution to this problem was proposed by Heckman (1979), who used a system of simultaneous equations with Mills' ratio as a new variable to solve the problem.

Heckman (1979) proposed to estimate equation with a simultaneous equation system in two stages. The first stage of the procedure is to estimate the probability of being formal in order to obtain the inverse Mills ratio, the second stage is estimate the wage equation adding the inverse Mills ratio as independent variable.

As seen in Heckman (1979), to set up the model correctly we need variables that affect the probability of being formal but do not affect wages. The chosen variable is the position the worker has in his family. We assume that being head of the family does not affect wages conditioned on its status (i.e. being formal or informal). In other words, we assume that being head of the family affects the probability of being formal but does not affect the workers' wage⁸. Therefore, the first stage equation contains all independent variables of Table 1 except the

⁸ Labour rights like social security can be passed to partner or sons. Therefore, head of the family may have more incentives to be formal.

variable *relative*. The potential problem in this identifying assumption is that we can not be certain this assumption is totally correct.

In order to estimate formal and informal wages and wage differentials controlling for workers observable characteristics and sample selection, we run the following regressions (first stage is omitted):

$$\text{Log}W_{i,s,t}^F = \chi_{s,t}^F N_{i,s,t}^F + o_{s,t}^F \text{Mills}^{\text{Formal}} + \eta_{i,s,t}^{F,He} \quad (2)$$

$$\text{Log}W_{i,s,t}^I = \chi_{s,t}^I N_{i,s,t}^I + o_{s,t}^I \text{Mills}^{\text{Informal}} + \eta_{i,s,t}^{I,He} \quad (3)$$

If the $o_{s,t}^F$ is significant there is a problem of sample selection an this model corrects for it.

After doing the regressions on the model for all the states, we finally obtain 881 estimated wages, $\overline{\text{Log}\hat{W}_{s,t}^{F,sel}}$ and $\overline{\text{Log}\hat{W}_{s,t}^{I,sel}}$, and wage differentials:

$$\overline{\text{Log}\hat{W}_{s,t}^{F,sel}} - \overline{\text{Log}\hat{W}_{s,t}^{I,sel}} = dsel_{s,t}.$$

D. Relationship between wage and unemployment

We deal with cross-sectional and time series data. A common specification problem when working with longitudinal data is unobserved heterogeneity across groups of the sample.

There are two main models of panel data that deal with unobserved heterogeneity: fixed effect and random effect.

In order to estimate models with unobserved heterogeneity, it is necessary to make some assumptions about the heterogeneity behavior. There are two main assumptions that fundament two panel data models (Greene, 2003):

1. The unobserved heterogeneity does not change in time and it is correlated with the independent variables (fixed effect model).
2. The unobserved heterogeneity is not correlated with the right hand side variables (random effect model).

We consider that workers and firm characteristics can be correlated with regional unobserved heterogeneity. Therefore, we consider that the fixed effects model is suitable to estimate the relationship between unemployment and differentials between formal and informal wages across regions.

Thus, we estimate the following equation:

$$W_{st} = U_{st}\beta + D\alpha + \varepsilon_{st} \quad (4)$$

Where D is a $ST \times S$ matrix (S total number of states and T is total number of periods) formed by d_i , dummy variables indicating the sth state, $D = [d_1 d_2 d_3 \dots d_S]$, U_{st} is unemployment and W_{st} is wage in state s and time t .

V. Results

Table 2 shows the results of the estimation of the unemployment rate coefficient (β) of equation (4) using six different dependent variables (which were explained in the former section), raw wages: $\text{Log}W_{s,t}^{F,raw}$ and $\text{Log}W_{s,t}^{I,raw}$, wages estimated controlling for observable characteristics: $\text{Log}\hat{W}_{s,t}^{F,cont}$ and $\text{Log}\hat{W}_{s,t}^{I,cont}$; and wages estimated controlling for observable characteristics and sample selection: $\text{Log}\hat{W}_{s,t}^{F,sel}$ and $\text{Log}\hat{W}_{s,t}^{I,sel}$. In Table 3 we show the results of the same estimation as above but using wage differentials as dependent variables: raw differentials ($draw_{s,t}$), controlling for observable characteristics ($dcont_{s,t}$) and controlling for observable characteristics and sample selection ($dsel_{s,t}$).

First we describe Table 2. Raw wages regressions do not show a significant effect of unemployment on wages in the formal nor in the informal sector. However, once we control for observable characteristics, both formal and informal sectors show evidence of a negative correlation between unemployment and wages. Under this specification, the coefficient of unemployment in the formal sector is -1.90 and in the informal sector is -2.25 . Yet, we can not reject H_0 that both coefficients are different to each other. This would suggest that there is no difference of flexibility between the formal and informal sector. However, when we control for observable characteristics and sample selection (bottom two rows of the Table), an interesting result arises.

In the formal sector we did not find that unemployment statistically affects wages. On the other hand, we find a strong negative relationship between unemployment and wages in the informal sector.

Table 2. Estimation of the coefficient of unemployment.

Dependent variables		Coefficient	Std. error	<i>t</i>	<i>p</i> > <i>t</i>
Raw Wages	<i>Formal</i>	1.631	1.353	1.21	0.228
	<i>Informal</i>	-1.636	1.131	-1.45	0.149
Estimated wages controlling for observable characteristics	<i>Formal</i>	-1.900	0.221	-8.61	0.000
	<i>Informal</i>	-2.255	0.284	-7.93	0.000
Estimated wages controlling for sample selection	<i>Formal</i>	0.161	0.361	0.54	0.656
	<i>Informal</i>	-5.138	0.717	-7.17	0.000

Independent variable: unemployment

Number of observations: 881

Number of groups: 32

We now describe Table 3. The first row corresponds to raw wage differentials. The coefficient of unemployment is 2.036 and is significant at 95% confidence level. This contrasts with the results of raw wages described in Table 2 that showed a non-significant effect of unemployment on wages in both formal and informal sector: This result emphasizes the relevance of studying the effect of unemployment on both wage differentials and wages. When we control for observable characteristics, the coefficient of unemployment falls to 0.356 but is still significant at 10% level. If we control for observable characteristics and sample selection, the coefficient of unemployment rises to 5.299 and is found to be significant at 1% level. These results show evidence that the informal labour market is more flexible than the formal and that distortions of the Mexican labour market (measured as wage differentials obtained after controlling for observable characteristics and sample selection) increase during volatile times, i.e. economic crises. However, these results may be biased due to the endogeneity of the unemployment rate. In the following section we describe the problem and propose an estimation that may contribute to overcome this problem.

As explained before, in order to estimate wages we estimate formal and informal wage equations for each quarter and state during the study period. Therefore, we obtained a coefficient associated to the sample selection problem ($\alpha_{s,t}$) per estimation (see equation 2). From all

regressions made to estimate wages, the coefficient $\alpha_{s,t}$ was significant in almost 85% of cases. Thus, sample selection between formal and informal workers seems to be a significant issue across states and time, we consider then this as the best specification to estimate wages.

Table 3. Estimation of the coefficient of unemployment.

Dependent variables	Coefficient	Std. error	t	$p > t $
Raw differentials (<i>draw</i>)	2.037	0.259	7.81	0.000
Controlling for observable characteristics (<i>dcont</i>)	0.356	0.198	1.80	0.073
Controlling for sample selection (<i>dsele</i>)	5.299	0.838	6.32	0.000

Independent variable: unemployment

Number of observations: 881

Number of groups: 32

VI. Endogeneity of unemployment rate

A possible problem in the former specifications is the endogeneity of the unemployment rate.

Consider the regression:

$$W_{st} = U_{st} \beta + \varepsilon_{st} \quad (5)$$

Where W_{st} is wage in state s and time t and U_{st} is the unemployment rate. One of the assumptions of the classical regression model is the exogeneity of the independent variables:

$$E[\varepsilon_{st} | U_{st}] = 0.$$

However, this condition may not hold in this estimation. For example, in the case of negative shock to the economy, the same shock affects the level of employment and wages, subsequently:

$$\text{Cov}(\varepsilon_{st}, U_{st}) \neq 0, \quad (6)$$

therefore

$$E[\varepsilon_{st} | U_{st}] \neq 0.$$

Hence one of the assumptions of OLS (exogeneity of the independent variables) is not valid.

We can solve this problem using an Instrumental Variables (IV) procedure. In order to be valid, the set of instrumental variables should be directly related to U_{st} , but should be uncorrelated (other than indirectly, through their effect on unemployment) with wages (W_{st}).

The dynamic of unemployment implies that if an economy receives an exogenous shock in $t-1$, then the level of unemployment in t will be affected

$$U_{s,t} = \rho U_{s,t-1} + u_{s,t}, \rho \neq 0. \quad (7)$$

Therefore a possible IV variable is the lag of the unemployment rate $Cov(\varepsilon_{st}, u_t) \neq 0$ but $Cov(\varepsilon_{st}, u_{t-1}) = 0$.

Hence we can estimate the following equation:

$$W_{st} = U_{s,t-1} \beta + \zeta_{st}$$

However, even if $Cov(\varepsilon_{st}, u_{t-1}) = 0$, $U_{s,t}$ can still be correlated with $U_{s,t-2}$. If this is the case we still have an endogeneity problem, but now with the lag of the dependent variable.

A solution to this problem was proposed by Arellano and Bond (1991). Equation 5 can be estimated by the Generalized Method of Moments (GMM) estimation in differences with lags of the independent variable. This estimation takes full advantage of the orthogonality conditions of the lags in levels of the dependent variable and lags of the endogenous independent variable ($U_{s,t}$ in this case) and allows for overidentification test that verifies the validity of the orthogonality conditions. In order to estimate the parameters of interest, GMM models require the specification of some moment conditions.

Another advantage of this specification is that, because it includes lags of the dependent variable, unemployment, it also gives information

about the speed of adjustment of the labour market. Now we briefly describe the Arellano-Bond 1991 model:

$$W_{st} = \delta W_{st-1} + \beta U_{st} + \alpha_s + \varepsilon_{st}, \quad \alpha_s + \varepsilon_{st} = \eta_{st} \quad (8)$$

On the right hand side, we have now a lag of the dependent variable. The term α_s is the state-specific fixed effect. The lag of the dependent variable is correlated with the disturbance. Therefore, simple fixed or random effects estimator is biased on finite samples and its variance does not tends to zero, as the number of observation increases.

Fixed effects can be taken out of the model if we obtain first differences:

$$W_{st} - W_{st-1} = \delta(W_{st-1} - W_{st-2}) + \beta(U_{it} - U_{i,t-1}) + (\varepsilon_{it} - \varepsilon_{i,t-1}). \quad (9)$$

Without group effects, we can use instrumental variables estimators; we use different lags of the dependent variable as instruments. Arellano and Bond (1991) showed that there is more information in the sample that can be used with a GMM estimator. As we saw above, we know that the unemployment (U_{it}) is endogenous.

Sargan Test An important issue in GMM models is the validity of the orthogonality conditions. In order to test the orthogonality restrictions Arellano and Bond (1991), proposed a Sargan (1958) overidentification test.

If the model is correctly specified, the mean of the sum of all moment conditions evaluated in $\hat{\beta}$ should be close to zero.

Therefore, the Sargan test allows us to verify the validity of these new instrumental variables. Thus, the Arellano and Bond model allows us to estimate $\hat{\beta}$ consistently, even if

- ε_{it} are serially correlated and
- $Cov(\varepsilon_{it1}, X_{it2}) \neq 0$ for all $t_1 \neq t_2$.

A. Discussion

Since the best specification to estimate wages is controlling for observable characteristics and sample selection, we decide to present Arellano Bond results using this specification⁹. In Tables 4 and 5 we estimate equation 9 for different measures of wages.

As seen in Arellano and Bond (1991), the autocovariance of the residuals of order 1 need not to be zero. The results of the Arellano-Bond test show that there exists first order serial correlation. However, the consistency of the GMM estimators depends heavily on the assumption that the autocovariance in the residuals of order 2 is equal to zero. All regressions presented in this section comply with these two conditions.

Table 4 summarizes the results estimated separately for formal and informal workers. Both regressions contain two lags of the dependent variable. These results are consistent with previous results. In the formal sector there is no evidence that unemployment affects wages. On the other hand, in the informal sector, unemployment negatively affects wages at 99% confidence level. The elasticity of wages in the informal sector to changes in unemployment is -2.8. Other interesting result arises if we compare the coefficient of the lags of the dependent variable. In the formal sector, the coefficient of the first lag is 0.148 and the coefficient of the second lag is 0.105. When looking at the standard error of each coefficient we see that these are not statistically different from each other. In contrast, in the informal sector regression, the coefficient of the first lag of wage is almost three times the coefficient of the second lag. This could be evidence that wages in the informal sector adjust quicker to shocks to the economy.

The results of Table 5 (wage differentials) show that after controlling for the endogeneity of the unemployment rate and workers' observable characteristics, wage differentials increase when the unemployment rate increases. Indeed, the coefficient of unemployment is positive (2.412) and represents the elasticity of wage differentials with respect to changes in unemployment. The importance of this finding

⁹ Result tables of Arellano Bond models using other methods to estimate wages (controlling for observable characteristics and raw wages) are available upon request.

Table 4. Controlling for serial autocorrelation.

Indep. var.	Coef.	Std. err.	z	$p > z $	Indep. var.	Coef.	Std. err.	z	$p > z $
<i>Constant</i>	-0.014	0.006	-2.25	0.025	<i>Constant</i>	-0.175	0.011	-1.55	0.121
<i>Wformal</i> _(t-1)	0.148	0.040	3.70	0.000	<i>Winformal</i> _(t-1)	0.232	0.038	6.04	0.000
<i>Wformal</i> _(t-2)	0.105	0.038	2.76	0.006	<i>Winformal</i> _(t-2)	0.081	0.037	2.19	0.028
<i>U_v</i>	-0.510	0.535	-0.95	0.340	<i>U_v</i>	-2.786	0.947	-2.94	0.003

Dependent variable: *Wformal*Dependent variable: *Winformal*

Dep. var. are estimated by controlling for workers observable characteristics and sample selection.

Number of observations: 785

Sargan test of over-identifying restrictions (Ho: orthogonality conditions are not valid):

chi2(348) = 405.48 Prob > chi2 = 0.018

chi2(348) = 382.98 Prob > chi2 = 0.0710

A-Bond test that average autocovar. in res. of order 1 is 0

Ho: no autocorr. z = 20.72 Pr > z = 0.000

Ho: no autocorr. z = -18.85 Pr > z = 0.000

A-Bond test that average autocovar. in res. of order 2 is 0

Ho: no autocorr. z = -0.48 Pr > z = 0.6317

Ho: no autocorr. z = -1.28 Pr > z = 0.200

becomes evident when interpreting these results. An increase of 10% in the unemployment rate implies a 24% increase in the wage differential between formal and informal employment. It is important to remember that these wage differentials are estimated after controlling for workers' observable characteristics and for regional non observed effects. In this context, formal-informal wage differentials can be viewed as a form of labour market distortion¹⁰. Therefore, important changes in unemployment (observed during economic crises) can increase formal-informal wage differentials and, as a result, rise the distortions of the labour market.

Another result that is worth to underline is that taking into account the dynamic of the wage differentials in time is important. The coefficients of the first and second lag of the wage differentials are significant at 99% of confidence. That is, shocks on the economy have decreasing effects on wage differentials between formal and informal workers that last six months.

There are obvious advantages in having a flexible labour market: For example, if a flexible labour market receives a negative demand shock, wages will decrease but unemployment will suffer little change, thus spreading the cost of the crisis among the majority of the workers. Flexible labour markets are characterized by being more competitive

¹⁰ If all formal-informal wage differentials are explained by non pecuniary benefits of informal work, formal-informal wage differentials should not be sensible to changes in unemployment.

and more productive. This also implies an economy that is better able to adapt to the changing economic environment.

Table 5. Controlling for serial autocorrelation.

Variables	Coefficient	Std. error	z	$p > z $
Constant	0.009	0.012	0.74	0.457
$dse_{(t-1)}$	0.193	0.040	4.81	0.000
$dse_{(t-2)}$	0.029	0.037	0.79	0.432
U_v	2.412	1.140	2.12	0.034

Dependent variable: dse

Number of observations: 785

Sargan test of over-identifying restrictions:

Ho: orthogonality conditions are not valid

$\chi^2(312) = 348.27$ Prob > $\chi^2 = 0.077$

A-Bond test that average autocovar. in res. of order 1 is 0

Ho: no autocorrelation $z = -17.54$ Pr > $z = 0.000$

A-Bond test that average autocovar. in res. of order 2 is 0

Ho: no autocorrelation $z = -0.66$ Pr > $z = 0.510$

Note: The default number of lags of the dependent variable to be used as instruments is $T-p-2$ where T is the number of quarters, p is the number of parameters. In this case the default number of lags of the dependent variable to be used as instrument is 26. However, in order to improve the specification of this model we limit this number to 18.

These findings show evidence of the existence of differentiated flexibilities between formal and informal employment. As we saw in section I, there is more than one possible explanation for this situation: (bad) formal labour market regulations¹¹, differences in workers' effort observability, or differences in search frictions between formal and informal employment. All of these can explain differences in labour flexibility between formal and informal employment. In this study we cannot formally differentiate the effect from these three factors. However, these results offer a hint of which of these three factors may be more predominant. Indeed, the last two arguments can explain different formal-informal labour market flexibilities but cannot explain zero flexibility in one sector. In this study, zero flexibility would be

¹¹ The identification of the labour market regulations affecting the flexibility of the formal sector is beyond the scope of this work. It is clearly important (for welfare as well as efficiency reasons) to support workers during unemployment periods. However, the current Mexican firing indemnification system seems to hamper formal labour market flexibility. This system could be changed for a less distortionary indemnification system like the Chilean unemployment insurance, "Seguro de Cesanta" (Acevedo, Eskenazi, and Pagés, 2006). Under this system, workers, government and employers contribute to an individualized workers account. If fired, the worker can use this account to finance his/her unemployment spells.

a non-significant effect of unemployment on wages. Given that a significant statistical effect of unemployment on wages in the formal sector was not found, we can argue that the regulatory framework of the Mexican labour market may be a relevant issue in Mexico and that changes in the Mexican labour law can contribute to improve labour market flexibility.

Another important result of this study is that, if we consider formal-informal wage differentials as an indicator of labour market distortion, during volatile times (observed mainly during crises) the labour market distortion in Mexico increases, hampering the ability of the Mexican economy to recover.

VII. Conclusions

We showed that there are differences in labour market flexibility between the formal and the informal labour markets. On one hand, we could not find evidence that unemployment affects wages in the formal sector. On the other hand, we found a significant negative effect of unemployment on wages in the informal sector. Additionally, we found evidence that, controlling for observable workers' characteristics and unobservable regional effects, an increase of 10% the unemployment rate rises formal-informal real wage differentials by 24%.

The ENEU allowed us to analyze this relationship in two dimensions, across time and across regions. This permitted us to capture the information available in the heterogeneity between different Mexican states and differences in time. It also allowed us to use a more sophisticated econometric model for panel data analysis.

We started by estimating the link between unemployment and wages, using raw wage differentials. We then controlled for observable workers' characteristics, sample selection, non observable regional heterogeneity and endogeneity of unemployment. We found evidence that wages in the informal sector are more sensitive to changes in unemployment. Given unemployment endogeneity, the best specification to test wages; sensitivity to changes in unemployment is GMM in a dynamic panel data.

The findings of this paper are relevant for three reasons:

- First, because of the importance of having flexible labour markets.

It is important to underline that in this study we do not formally look at the reasons why the informal sector is more flexible than the formal one, however, the results can give us a general idea of what it may be happening. As we saw before, differences in labour market flexibility can be explained by at least three factors: labour market regulations, differences in search frictions and differences in workers' observable characteristics between the two types of labour. Each of these explanations implies different measures to increase labour market flexibility. However, the last two theories cannot explain zero labour market flexibility in the formal sector. Considering that we couldn't find a significant effect of unemployment on wages in the formal sector, the regulatory problem seems to be important in this context. As a result, changes in the Labour Federal Law and in local regulations can contribute to improve the flexibility of the Mexican labour market. However, we cannot underestimate the other explanations of poor formal labour market flexibility. If the problem is explained by differences in search frictions between formal and informal labour, a campaign focused on improving the information available to agents in the labour market can decrease the difference in labour market flexibility between informal and formal labour. Finally, if the differences in labour market flexibility are explained by differences in effort observability, measures to improve flexibility in the formal sector may be more difficult to implement, because the differences originate from the need to encourage workers with low effort observability to work harder; in other words, it would be in the nature of formal labour.

It may be that a combination of the factors described above explains the differences in flexibility between the two types of labour.

- Second, these results are important because they shed light on the dynamics of the Mexican labour market. We presented evidence

that during volatile periods, formal-informal wage differences increase as a consequence of changes in unemployment. If we consider wage differentials as a form of labour market distortion, periods of crises rise the distortion in the Mexican economy and, as a result, further obstruct the ability of the labour market to adapt to the new circumstances and delay the recovering of the Mexican economy. This is particularly relevant in the current international economic situation. Since the last quarter of 2008, Mexico and other countries are facing an unprecedented economic crisis where GDP and unemployment are expected to show a deep contraction during 2009. These results cast doubt about the capability of the Mexican labour market to quickly adapt to these new circumstances and start recovering.

- Third, wages are an important component of the inflationary process in all economies. Inflation is a serious concern in developing countries, and therefore, Central Banks need to follow wages closely in order to anticipate an increment in prices. Even though data and indicators from formal employment are important because of their precision and periodicity, it is important to remember that they do not cover the totality of the labour market. Thus, labour market research cannot rely exclusively on data and indicators from formal sectors, especially in countries with a significant amount of informal employment, such as Mexico.

The next step in this line of research may be to formally identify the sources of the differences in the labour flexibility between formal and informal workers, with the aim of implementing efficient measures to improve the flexibility of the labour market as a whole. Although it lies outside the scope of this analysis, improving the flexibility of the formal labour market could increase the attractiveness of formal labour, and therefore lead to an increase in the proportion of formal workers in the economy. This could bring some benefits to the economy such as an increment on the benefits related with formal jobs: i.e., an increased number of workers with access to social security, access to financial markets and rise government tax revenues, among others.

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