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# Labor flexibility and regional unemployment in Mexico: a panel cointegration analysis

# Flexibilidad laboral y desempleo regional en México: un análisis de cointegración de panel

Eduardo Mendoza-Cota*

***Abstract***

*In order to corroborate the long-term effect of increasing temporary labor contract on the unemployment rate of the Mexican formal workers, a cointegration panel model was estimated. The results indicated the existence of panel cointegration of the series considered. They showed that causality goes from the unemployment rate and wages to the labor flexibility index. The estimations exhibited positive coefficients for the labor flexibility variable. It can be concluded that the evidence provided by the estimation of the model suggests that increasing labor flexibility increases the unemployment rate but temporary labor contracts have had negative effects on that rate.*

***Keywords***: labor market, unemployment, wages, labor flexibility, cointegration panel.

**Resumen**

Con el fin de corroborar el efecto de largo plazo de la flexibilidad laboral numérica en la tasa de desempleo de los trabajadores formales de México, esta investigación utiliza la metodología de cointegración de panel. Los resultados mostraron la existencia de cointegración de las series utilizadas e indican que las variables explicativas del modelo causan la tasa de desempleo. La estimación exhibió coeficientes positivos para la variable de flexibilidad laboral numérica; la evidencia de las estimaciones sugiere que el incremento de la flexibilidad laboral numérica ha incrementado la tasa de desempleo, aunque los contratos laborales temporales afectan negativamente a dicha tasa.

**Palabras clave**: mercado laboral, desempleo, salarios, flexibilidad laboral, cointregración de panel.

* El Colegio de la Frontera Norte, México, correo-e: emendoza@colef.mx

## Introduction

The economic liberalization undertaken in Mexico since the decade of the eighties has created a more competitive international environment for trade and capital flows. These economic policy modifications required a restructuring of the Mexican labor market, in particular, since the establishment of the North American Free Trade Agreement (NAFTA) in 1994, the labor flexibility theme was discussed as another mechanism to adjust the productive sector of the Mexican economy to align with international conditions. Specifically, the neoliberal model required changes in the role of labor unions and collective contracts in order to increase labor flexibility.

As a result, important changes in the general conditions of labor have been experienced since 1994, particularly in firms with larger number of workers, technological innovations, higher levels of investment (particularly foreign investment), and located in industrialized regions such as Mexico City, Guadalajara, Monterrey, Tijuana, Puebla, etc. However, in the period 1994-2000, productive restructuring and labor flexibility were characterized by limitations on actions for organizing labor and by a restricted use of more technologically advanced processes of labor (Tunal, 2002).

Labor market conditions began to change with the implementation of the federal labor law reforms of 2012. Arguably, the main objectives of that reform, approved by the congress during the transition period between the governments of Felipe Calderón and Enrique Peña, were based on the premise that labor flexibility would encourage job creation and improve labor conditions. In particular, one important aspect of the labor reform was related to labor market flexibility, which was considered the basis for the attraction of capital and for the development of higher levels of labor productivity.

Studies regarding the effect of labor market flexibility on unemployment have presented diverse results. On one hand, a study by the IMF applied a static and dynamic panel models, with data from 97 countries during the period 1980 to 2008 (Bernal-Verdugo *et al.*, 2012), to test the effect of labor market regulations on unemployment and whether labor market flexibility affects unemployment over time. The authors considered the following as indicators of labor flexibility: hiring and firing regulations, centralized collective bargaining, and mandated cost of work dismissal. The results indicated that, after controlling by macroeconomic and demographic variables, the changes in the flexibility of the labor market regulations have a negative impact on the level of total, youth, and long-term unemployment. The results also showed that labor market flexibil-

ity and the financial crisis determined the behavior of unemployment, and that those countries with more labor rigidities had persistent unemployment.

On the other hand, several studies have found a positive relationship between job provisions and the level of employment. Di Tella and MacCulloch (1999) used a panel data set for 21 OECD countries during 1984-1990 and estimated a dynamic model to evaluate the effect of a flexibility index. The indicator was constructed with information on regulations such as provisions on part-time work, severance payments, etc. The results provided evidence that economies with more flexible labor markets have lower unemployment rates and a lower proportion of long-term unemployment. The limitations of the paper are related to the lack of definition of the enforcement of the different regulations.

A more recent paper stresses the importance of studying the relationship between unemployment and labor flexibility at the regional level (Bande and Karanassou, 2007). Using a stationary panel data model and impulse response functions to analyze the Spanish economy for the period 1985-1991, the authors found that the degree of labor flexibility, understood as taxes and benefits for labor, varies among the Spanish regions and that the major determinant of unemployment are the variations on investment. These results challenged the hypothesis that changes in unemployment are caused by taxes or benefits.

Based on a search and matching model, Cahuc and Postel-Vinay (2001) developed a model to analyze the impact of dismissal polices and temporary workers in the creation or destruction of jobs. The results showed that the increase in temporary workers can encourage job creation, but that it could be offset by increasing turnover due to the cost of firing or the lack of labor productivity.

In the context of mixed empirical results on the role of labor flexibility, the objective of the paper is to analyze the impact of numerical labor flexibility on the employment and wages of Mexican workers who are employed in the formal sector of the Mexican economy. The methodology of the study is based on a panel cointegration model that relates the rate of unemployment with a labor flexibility index based on the workers registered in the Mexican Institute of Social Security at the state level for the period 2005-2013.

The paper is structured as follows: in the first section, a discussion of the determinants and the effect of labor flexibility on labor employment are presented. In section 2, the analysis of labor flexibility and the definition of numerical labor flexibility are shown. In section 3, the empirical strategy and panel cointegration analysis are discussed. Section 4 describes the results of the panel cointegration estimations about the relationship

between the labor flexibility and the unemployment. Finally, the conclusions of the findings are presented in section 5.

## Empirical findings of the relation between labor flexibility and labor employment

The conventional approach to labor rigidity assumes that interventions in the labor market increase the costs of hiring labor and that the firm would reduce employment until labor productivity offsets the wage costs. Therefore, labor market interventions such as minimum wages, costs of firing, and union rights represent distorting costs of hiring labor. Based on that perspective, the labor market flexibility concept was established in the eighties in the developed economies, in order to underline the obstacles that labor market rigidities impose for economic growth. Thus, labor policies promoting the increased flexibility of labor markets as a means to encourage economic activity were proposed (Lagos, 1994).

Therefore, the concept of labor cost flexibility is related to the sensitivity of employment and nominal wages to economic conditions. The flexibility of labor can be achieved by different policies that affect the conditions of the labor market. On one hand, numerical flexibility consists of the capacity of firms to adjust the number of workers when there are technological and demand changes (external), and to the flexibility of working hours as an alternative for wage adjustments (internal). On the other hand, functional flexibility is related to institutional resources and human resource practices that provide workers with multiple skills so they can move from one productive task to another and respond to changes in technology (Kalleberg, 2001).

Consequently, according to this approach to labor flexibility, excessively regulated labor markets cause distortions to economic markets, making it necessary to eliminate labor market regulations that prevent the absorption of the labor supply and the incorporation of technological changes. From this perspective, higher wages, long term labor contracts, higher cost layoffs, and the lack of a flexible work hours system are important determinants of unemployment. However, several objections to this approach have arisen. For instance, it has been argued that the effect of labor rigidities on the expansion of unemployment requires that the cost of labor rigidities is only paid by the firm, which is an extreme assumption (Ramos, 2007).

Generally, the approach to the study of labor flexibility has been based on a set of proxy variables for the institutional factors affecting the labor market which have been presented by various authors in diverse papers on labor flexibility. Among them, union strength, labor supply charac-

teristics, and unemployment benefits have been considered. However, the limitation of available and comparable quantitative databases determines the lack of comprehensive studies (Baker, *et al*, 2004). Hence, conceptualizations of labor flexibility depend on the characteristics of the labor markets that are being considered.

Major empirical studies on labor flexibility and unemployment in developed economies have shown mixed results. During the decade of the nineties, a study of the effect of labor rigidities on unemployment in the main economies of Europe was estimated. The regression model was based on a data base for the period 1989-2004 and included key indicators of the labor market rigidities for 20 European countries, such as employment protection, benefit duration, union density, and union coverage, among others; and concluded that the rigidity of the European labor market has contributed to the high unemployment experienced in those economies (Nickell, 1997).

Following this approach, several papers have presented estimations showing that labor flexibility can reduce unemployment. Di Tella and MacCulloch (1999) used a panel data of 21 OECD countries for the period 1984-1990. The results indicated that the economies with more flexible labor markets had lower unemployment rates. Cahuc and Postel-Vinay (2001) analyzed the impact of dismissal polices and temporary workers on unemployment. The estimations suggest that temporary workers can encourage job creation. Additionally, the results of another study applied static and dynamic panel models, with data from 97 countries during the period 1980 to 2008, pointed out that enhancing flexibility reduces the level of total youth and long-term unemployment (Bernal-Verdugo *et al.*, 2012). A recent paper, using panel data, estimated the effect of the introduction of temporary contracts in the Spanish economy on manufacturing firms (Aquirregabiria and Alonso, 2014). The results showed that the impact of the labor reform was modest. The authors argued that temporary contracts have led to increases in employment and job turnover for inexperienced workers.

On the other hand, there are several papers that have exhibited opposite results, showing negative effects of labor flexibility on the level of unemployment and a worsening of labor conditions. Based on the analysis of labor policies in 11 countries of the OCDE and their effect on labor markets, Kahn (2010) found that increasing labor flexibility could bring workers into the regular labor market but will also create labor insecurity for already employed workers and increase wage inequality. Regarding the relationship between unemployment and labor flexibility at the regional level, (Bande and Karanassou, 2007) analyzed the Spanish economy for the period 1985-1991; the results showed that labor flexibil-

ity is a major determinant of unemployment. Gebel and Giesecke (2011) used cross-sectional information on individuals employed or unemployed for the period 1992-2007 for 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, and the United Kingdom. The regression estimations suggested that the deregulation of the use of temporary contracts has not had a positive impact on reducing the divide between high and low skilled workers, and therefore, it has reduced the possibility of an increase in total employment. The flexibility of temporary labor has only encouraged the substitution of low skilled permanent jobs by temporary jobs.

Fort the case of the Mexican economy, there are a few papers that presented results supporting the evidence of a positive correlation between labor market flexibility and employment. Using a panel data model for the period 1995-2001 and estimations of wage differentials for the formal and informal sectors, Alcaraz (2009) estimated a fixed effect and dynamic panel model to evaluate the correlation between wage differentials and unemployment in both sectors. The results showed a significant negative effect of unemployment on wage differentials; although there was heterogeneity across regions. The author argues that the results indicate that wage differentials are due to the lack of labor flexibility in the formal sector.

On the other hand, among the papers supporting a positive impact of labor flexibility on unemployment in the Mexican economy, one of them proposed that the labor market is segmented into the tradable and non-tradable goods sectors (Frenkel and Ros, 2004). The first sector is characterized by labor intensive jobs for the manufacturing and maquiladora sectors; the second, oriented to the domestic market, has shown increasing flexibility of labor, resulting from the increasing employment in the informal market. Additionally, it is considered that the expansion of labor competitiveness has been related to changes in the exchange rate rather than to increases in labor productivity. In this context, the approach to reducing labor unemployment based on the assumption that implementing additional liberalizing reforms and the increase of labor flexibility in terms of the labor laws and regulations, do not guarantee the reduction of unemployment.

A recent study on the Okun law and labor flexibility in Mexico was estimated for the period 1997-2014 (Loría *et al.*, 2015). The authors used a vector error correction model, VECM, and estimated a high positive elasticity of unemployment with respect to the numerical flexibility employed. The authors concluded that the empirical evidence does not

support the reduction of unemployment by applying labor flexibility policies, as it has happened in developed economies.

The research on the impact of labor flexibility and unemployment in Mexico tends to provide more evidence of a positive correlation between these two variables. Therefore, increases in temporary workers resulting from laws aimed at increasing labor flexibility could generate a precarious labor environment. As a result, temporary workers would have less attachment to the firms and employers would be less committed to providing training to improve the labor skills, thus affecting labor productivity, economic growth, and employment (Alba-Ramírez, 1997).

## 2. Labor flexibility in Mexico

It has been pointed out that labor flexibility policies in Mexico were beginning to be implemented by the end of the decade of the eighties, with the establishment of capacity-based promotions and actions related to functional flexibility (De la Garza, 2010). Regarding numerical labor flexibility, the capacity to hire and lay off workers did not change until the new federal labor law was established in 2012. However, during the decade of the nineties, collective contracts controlled by corporative unions decreased, while the labor contracts of unions controlled by firms increased. Additionally, during this period, an expansion of workers with temporary contracts took place.

For this reason, it is possible to point out that there has been a trend towards labor flexibility and that the change in the federal labor law in Mexico has generated new conditions to enforce labor flexibility within the Mexican economy. Particularly, the labor reforms established new forms of outsourcing workers for the firms without a clear mechanism for preserving workers labor rights[1]. Another new element was the possibility of establishing temporary contracts because of probationary period or hourly paid labor[2].

Consequently, under the new reformed labor law that allows for changes in numerical labor flexibility, firms can increase or decrease labor employment without having to spend in legal or benefit expenses. However, it is important to point out that, in the Mexican case, it is not conclusive what the effect of labor reforms will be on employment. Considering that flexible hiring practices already existed in the informal markets, it is uncertain to what point the reforms would be able to increase

[1] Mexican Federal Labor Law. Last Reform, Chapters 15-A, 15-B, 15-C and 15-D pp. 4-5 (*DOF*, 2015).

[2] Mexican Federal Labor Law. Last Reform, Chapters 25, 35, 39-A, 39-C, 39-F, 42 and 48 pp. 7-13 (*DOF*, 2015).

employment and attract workers form the informal markets (Miranda and Salgado, 2013). Therefore, it becomes an important task to analyze and estimate the correlation between labor flexibility and employment.

### *2.1. Labor flexibility and temporary workers*

In this paper, the approach to labor flexibility is based on the estimation of an index of numerical labor flexibility. As mentioned before, labor flexibility helps to reduce costs by using non-full time workers and reducing the number of workers who are hired with contracts for specific periods depending on the need of the firms (Kallenberg, 2001). Therefore, one of the principal components of labor flexibility has to do with the capacity of firms to hire temporary workers. In other words, the possibility of a labor force adjustment due to changes in the final demand for goods, structural changes, and economic recessionary shocks. In order to have labor flexibility in terms of the development of non-permanent ties of the workers with their employer, labor laws have to allow labor cost adjustments of hiring, retirement, and health programs, among other costs (Wiens-Tuers, 2001).

For the case of the Mexican economy, it can be argued that one of the most important determinants of labor flexibility is based on increasing temporary workers (numerical flexibility), which began to be implemented as a part of the liberalization reforms during the decade of the nineties. Particularly, in recent years, we can observe an important increase in numerical flexibility.

For this paper, following Loría *et al.*, (2015), the numerical flexibility index was constructed with information on permanent and temporary workers that are affiliated and are paying contributions to the Mexican Institute of Social Security (IMSS), which is an institution that provides health care and pensions. The numerical flexibility index was constructed by adding the urban and rural temporary worker categories. Formally, the index was calculated as follows:

$$NLFI = \frac{TL}{TL + PL} \qquad (1)$$

Where:
NLFI = labor flexibility index[3]
TL = temporary contract workers
PL = permanent contract workers

[3] Temporary labor is a category made up by urban and rural temporary workers registered in the IMSS.

The estimations of the labor flexibility index in Mexico showed that the indicator increased by 30,75% between March of 2005 and August of 2014. This result corroborates the expansion of the number of workers with temporary contracts in the formal labor market of the Mexican economy. It is worth mentioning that between January of 2005 and September of 2014, the average monthly growth rate of permanent workers was 13,5% at the national level, while for temporary workers it was 18,5% (table 1).

**Table 1**
**Mexico: Average monthly growth rate of permanent and temporary labor employment by states (2005-2014)**

| *State* | *Permanent labor* | *State* | *Temporary labor* |
|---|---|---|---|
| Querétaro | 16,44% | Zacatecas | 28,13% |
| Campeche | 16,15% | Tlaxcala | 27,61% |
| Tabasco | 16,14% | Michoacán | 23,27% |
| Chiapas | 15,20% | Quintana Roo | 22,92% |
| Guanajuato | 14,68% | Coahuila | 22,43% |
| Nayarit | 14,46% | Durango | 22,23% |
| San Luis Potosí | 14,36% | Hidalgo | 21,28% |
| Zacatecas | 14,33% | Querétaro | 20,62% |
| Nuevo León | 14,29% | Distrito Federal | 20,28% |
| Colima | 14,23% | México | 19,70% |
| Nacional | 13,54% | Nacional | 18,47% |

Source: own elaboration with data from the Mexican Institute of Social Security.

At the regional level, the states that showed the fastest rates of growth of temporary workers were Zacatecas, Tlaxcala, Michoacán and Quintana Roo, which are states lagging behind in terms of economic growth, with the exception of the latter, due to the tourism industry. However, the Estado de México and DF, which have large regional labor markets, experienced high rates of growth of temporary employment; this demonstrates that temporary employment is also growing in large urban areas, probably related to manufacturing and services activities.

As a result, the evolution of the numerical flexibility index by states showed that the states which are specialized in manufacturing activities, such as Coahuila, Chihuahua, Distrito Federal, Estado de México, and Puebla also have the highest rate of average annual growth of the numerical flexibility index as compared to the average annual rates of growth at the national level, in the period 2005-2013 (table 2).

## 2.2. Unemployment, wage and labor flexibility

Among the relevant effects that derive from increasing labor flexibility, the most important is its impact on the rate of unemployment and wages. Regarding the effect on employment, it has been argued that global competition and technological innovation in production and communications have shifted the demand for permanent workers with stable jobs to "temporary workers that can fit the new requirements of the production processes". Also, it has been argued that labor flexibility is a result of the demand for part-time jobs (Wiens-Tuers, 2002: 303).

In any case, it is possible to suggest that increasing labor flexibility is a characteristic of changes in the international economy. However, its impact on the level of employment and wages is not clear because it depends on institutional arrangements. For instance, on one hand, the numerical flexibility index grew from 12.39% in 2006 to 14.77 in 2013, which represented an average rate of growth of 19.25% (Table 3). Regarding wages, during the above-mentioned period, the annual average nominal hourly wage for formal workers increased by 35.1%; however, the real annual average wage augmented by only 0.82%.

Therefore, the rapid expansion of numerical labor flexibility has not affected increases in the income of labor workers in the formal market, although there is a slightly positive correlation between the two variables. On the other hand, the unemployment rate of the Mexican economy increased from an average of 3.26% in 2006 to 4.83% in 2013, which represented a rate of growth of 48.29% during this period. Therefore, according to the expansionary path taken by both variables, the increasing numerical flexibility has not been able to encourage employment sufficiently to reduce the unemployment rate (figure 1).

**Table 2**
**Labor flexibility numerical index for the states of Mexico 2005-2013**

| *Period* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *TCPA* | *2013/2012* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| National average | 12,24 | 13,08 | 13,37 | 13,35 | 13,36 | 14,24 | 14,87 | 15,40 | 15,44 | 2,9% | 0,3% |
| Aguascalientes | 8,71 | 9,34 | 8,81 | 8,05 | 8,92 | 9,73 | 9,99 | 9,83 | 9,91 | 1,6% | 0,9% |
| Baja California | 7,25 | 7,39 | 7,61 | 8,00 | 7,58 | 8,69 | 8,93 | 7,61 | 8,00 | 1,2% | 5,2% |
| Baja California Sur | 20,72 | 22,72 | 22,01 | 19,82 | 20,94 | 21,80 | 21,34 | 23,46 | 23,46 | 1,6% | 0,0% |
| Campeche | 21,59 | 21,81 | 21,89 | 23,66 | 20,81 | 20,79 | 19,74 | 21,39 | 21,94 | 0,2% | 2,6% |
| Coahuila | 8,42 | 8,43 | 8,73 | 9,83 | 11,03 | 12,02 | 12,60 | 12,23 | 12,22 | 4,7% | -0,1% |
| Colima | 15,98 | 16,56 | 15,92 | 15,55 | 15,79 | 17,74 | 18,31 | 17,46 | 18,88 | 2,1% | 8,1% |
| Chiapas | 11,31 | 11,05 | 9,95 | 10,51 | 10,97 | 10,52 | 10,94 | 9,96 | 10,96 | -0,4% | 10,1% |
| Chihuahua | 5,47 | 6,43 | 5,90 | 6,13 | 8,04 | 8,03 | 8,96 | 9,83 | 10,02 | 7,6% | 2,0% |
| Distrito Federal | 8,76 | 9,38 | 9,63 | 10,55 | 11,84 | 12,94 | 13,32 | 13,25 | 13,23 | 5,2% | -0,1% |
| Durango | 7,31 | 8,22 | 8,69 | 8,95 | 10,44 | 11,57 | 13,22 | 11,44 | 11,27 | 5,4% | -1,5% |
| Guanajuato | 10,30 | 10,60 | 10,53 | 10,66 | 11,57 | 12,11 | 13,15 | 12,93 | 13,08 | 3,0% | 1,2% |
| Guerrero | 19,28 | 21,26 | 20,44 | 20,60 | 19,45 | 18,96 | 19,81 | 18,37 | 20,01 | 0,5% | 8,9% |
| Hidalgo | 16,17 | 17,15 | 18,59 | 19,20 | 17,41 | 21,35 | 23,42 | 23,65 | 23,92 | 4,9% | 1,1% |
| Jalisco | 9,67 | 9,76 | 9,87 | 9,47 | 10,57 | 11,37 | 11,76 | 11,84 | 12,14 | 2,9% | 2,6% |
| México | 13,11 | 14,40 | 14,51 | 15,37 | 17,62 | 17,48 | 17,74 | 17,53 | 17,51 | 3,6% | -0,2% |
| Michoacán | 9,77 | 12,64 | 13,30 | 13,19 | 14,24 | 14,63 | 14,49 | 15,19 | 15,49 | 5,8% | 1,9% |
| Morelos | 11,69 | 12,35 | 12,32 | 12,44 | 12,95 | 13,01 | 13,31 | 12,67 | 13,22 | 1,5% | 4,4% |
| Nayarit | 25,13 | 23,58 | 21,54 | 20,05 | 19,97 | 17,88 | 19,65 | 19,11 | 20,80 | -2,4% | 8,9% |
| Nuevo León | 8,39 | 9,24 | 8,99 | 9,26 | 10,50 | 10,99 | 11,39 | 10,73 | 10,85 | 3,2% | 1,2% |
| Oaxaca | 12,34 | 11,34 | 11,85 | 12,13 | 12,58 | 11,61 | 13,87 | 14,57 | 15,03 | 2,5% | 3,1% |
| Puebla | 10,86 | 11,85 | 11,81 | 11,96 | 13,04 | 14,10 | 14,59 | 14,18 | 14,90 | 4,0% | 5,0% |
| Querétaro | 16,93 | 17,28 | 16,98 | 17,83 | 19,35 | 20,02 | 20,34 | 19,95 | 19,38 | 1,7% | -2,9% |
| Quintana Roo | 15,01 | 16,59 | 17,27 | 15,98 | 18,49 | 20,13 | 21,00 | 22,02 | 23,29 | 5,5% | 5,8% |
| San Luis Potosí | 14,30 | 15,07 | 14,74 | 15,01 | 13,21 | 14,49 | 15,43 | 16,36 | 16,54 | 1,8% | 1,1% |

*Continúa...*

| *Period* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *TCPA* | *2013/2012* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sinaloa | 14,24 | 14,57 | 18,33 | 15,30 | 14,01 | 13,05 | 12,92 | 13,68 | 16,57 | 1,9% | 21,1% |
| Sonora | 15,19 | 15,75 | 13,05 | 13,24 | 13,86 | 12,96 | 13,43 | 13,03 | 14,74 | -0,4% | 13,2% |
| Tabasco | 16,40 | 18,87 | 18,43 | 17,26 | 16,72 | 18,09 | 19,40 | 19,63 | 18,65 | 1,6% | -5,0% |
| Tamaulipas | 10,31 | 10,66 | 10,69 | 11,41 | 11,40 | 10,88 | 12,13 | 11,24 | 11,38 | 1,2% | 1,3% |
| Tlaxcala | 9,69 | 10,48 | 11,03 | 12,98 | 16,86 | 19,78 | 19,73 | 20,00 | 21,00 | 9,7% | 5,0% |
| Veracruz | 16,22 | 17,02 | 16,31 | 16,89 | 17,06 | 15,55 | 16,33 | 16,29 | 17,53 | 1,0% | 7,6% |
| Yucatán | 7,06 | 8,08 | 8,10 | 7,03 | 7,89 | 8,28 | 8,71 | 9,05 | 8,76 | 2,7% | -3,2% |
| Zacatecas | 9,49 | 11,06 | 12,30 | 14,11 | 15,56 | 17,57 | 17,14 | 16,73 | 16,38 | 6,8% | -2,1% |

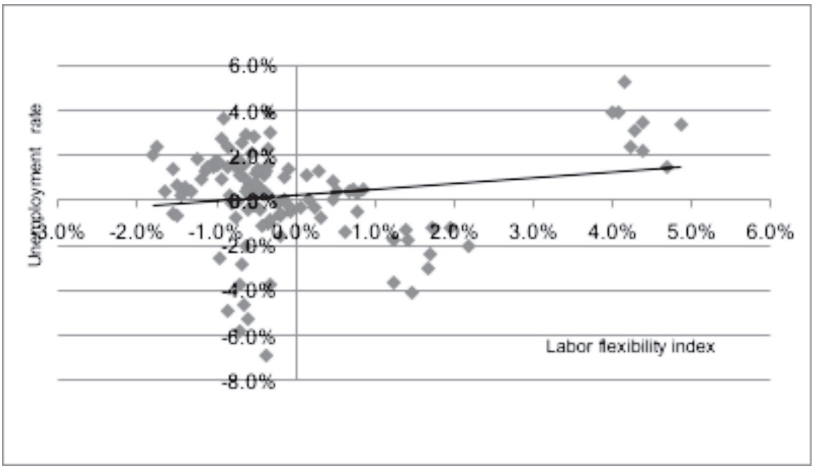
Source: own elaboration with information from the Mexican Institute of Social Security (Inegi, 2014).

**Table 3**
**Mexico: annual rates of growth of numerical labor flexibility wages and unemployment rate, 2013**

| | *Nominal wage (1)* | *Real Wage (2)* | *Unemployment rate* | *Flexibility index* |
|---|---|---|---|---|
| 2006 | 0,67% | -2,68% | 11,47% | 10,39% |
| 2007 | -0,22% | -3,34% | -2,82% | 7,74% |
| 2008 | 0,98% | -4,77% | 26,39% | 5,74% |
| 2009 | -1,92% | -5,09% | 18,82% | 8,97% |
| 2010 | -1,08% | -4,22% | -0,80% | 12,58% |
| 2011 | -0,45% | -3,64% | -8,06% | 7,44% |
| 2012 | -0,71% | -3,45% | 2,34% | 6,24% |
| 2013 | -1,38% | -4,77% | -7,76% | 3,19% |
| Average rate of growth | 35,06% | 0,82% | 48,29% | 19,25% |

Source: Mexican Institute of Social Security (IMSS), Inegi, 2014 (1) wage of permanent and temporary workers paying contributions to IMSS, (2) based on Consumer Price Index: 2010=100, PGR: percentage rate of growth, 2005/03-2013-12.

**Graph 1**
**Mexico: annual rates of growth of unemployment and labor flexibility index, 2006-2013**




Source: statistics of the Mexican Institute of Social Security, (Inegi, 2014).

## 3. Empirical strategy and panel cointegration analysis

### *3.1. Labor rigidities and labor demand*

The statements that support labor flexibility are based on the neoclassical analysis of labor market rigidities. This approach considers that labor rigidities increase, among other costs, the firm's cost of hiring more workers and if the marginal productivity of the new workers does not compensate for the increased costs, the firm will not hire more workers.

Additionally, increases in severance pay for dismissal increase the cost of firing workers, depending on the percentage of worker dismissals. As a result, the number of hired workers will decrease, depending on the elasticity of demand for labor. Generally, the effect of employment protection on the demand for workers has been demonstrated using matching models with endogenous job destruction (Kugler, 2004). From this approach, it is possible to describe the effect of labor rigidities on the demand for labor, by constructing a profit function that includes the costs of firing workers (Cahuc and Postel-Vinay, 2001).

According to this approach, the firms fire workers when the discounted profit of continuing to employ workers falls below the gain from firing them. In this case, labor rigidities are tantamount to an increase in the costs of firing for the employer. Therefore, from the mainstream labor theory, the protection of labor generates rigidities, such as increasing union power and shorter work hours that reduce the labor demand and increase unemployment.

### *3.2. Cointegration tests*

In order to study the effect of the labor flexibility on the unemployment rate in Mexico, a cointegration panel model was established. The regression form in the model has the following specification:

$$U_{it} = \alpha_1 + \alpha_2 F_{i} + \alpha_3 c_{i} + e_i \qquad (2)$$

Where

u = unemployment rate of state *i* at time *t*.

FI = flexibility index

W= wages paid to workers registered in the Mexican Institute of Social Security

The information of the database encompasses a monthly period from 2005 to 2013 and includes panel series by state for permanent and tem-

porary labor contracts, wages, and unemployment rates for formal workers that were obtained from the Mexican Institute of Social Security (IMSS). This institution is in charge of the social protection of Mexican workers in areas such as health coverage and administration of retirement pensions. The consumer price index (2010 = 100) was obtained from the Bank of Mexico statistics.

It has been demonstrated that pooled time series data can also exhibit a time trend and therefore could be non-stationary. As a result, estimations of ordinary least squares have the possibility of being spurious. In order to avoid misspecification errors, several authors have developed multiple series unit root tests for panel data structures. The tests are divided into two types. Breitung (2000), Levin *et al*. (2002) and Im *et al*. (2003) use Augmented Dickey Fuller tests, while Maddala and Wu (1999), Choi (2001) and Hadri (2000) use Phillip-Perron tests. The specification of the tests is formally presented in an AR(1) process for panel data as follows:

$$\Delta y_{it} = \mathrm{r}\, y_{t-1} + \sum \mathrm{b}_j \Delta y_{t-1} + X_t \mathrm{d} + v_t \quad \text{.....(3)}$$

Where

$y_{it}$ = pooled variable

$X_{it}$ = exogenous variables (geographical fixed effects and unit time trends)

$v_{it}$ = error terms (mutually independent disturbances).

In the model, if is considered weakly (trend-) stationary and if it is considered to have a unit root. The LLC and Breitung tests assume that there is a common unit root process for all the cross sections with a null hypothesis similar to the Augmented Dickey Fuller test. Therefore, it is assumed that $\alpha=\rho-1$ is equal across the three cross-sections. Only the IPS test estimates a separate ADF regression for each of the three cross sections and therefore $\rho$ could be different in each cross-sections.

Additionally, in this paper the methodology developed by Pedroni (1999, 2004) that extended the Engle and Granger tests in order to include panel data is used. The test analyzes whether the residuals of the variables are cointegrated I(0) or not I(1). The difference is that, in the case of panel statistics, the first-order autoregressive term is assumed to be the same for all the cross sections. On the other hand, in the case of group panel statistics, the heterogeneous intercepts and trend coefficients can vary over the cross sections. The model is specified as follows:

$$y_{it} = \alpha_i + \delta_i t + \beta_{1i} X_{1i,t} + \beta_{2i} X_{2i,t} + \ldots + \beta_{Mi} X_{Mi,t} + \varepsilon_{i.t} \qquad (4)$$

Where y and x are assumed to be cointegrated of order one $I(1)$, and the parameters $\alpha$ and $\delta$ are individual and trend effects. The null hypothesis assumes no cointegration of the residuals $I(1)$ and is tested by running a regression of the residuals $\varepsilon_{i,t}$, and constructing a cointegration statistic that varies depending on the values of $N$ and $T$.

### *3.3. Fully modified least squares analysis*

Generally, most of the economic time series are difference stationary, and therefore a regression based on variables in levels will produce misrepresentative results, and the Wald tests for coefficient significance will exhibit spurious relationship between series. Therefore, to avoid that problem, it is important to determine the existence of a cointegrating vector. For that purpose, a fully modified ordinary least squares model (FMOLS) was estimated in this article. The method was developed by Phillips and Hansen (1990) with the objective of removing the long-run correlation between the stochastic regressors and the cointegration equation.

This estimation technique generates consistent estimates of the parameters and it also limits correlation and the endogeneity of the regressors. As a result, the estimator of this method is considered asymptotically unbiased, and therefore allows for standard Wald tests. Thus, the model developed is aimed to estimate the effect of numerical labor flexibility on the unemployment rate long-run estimates of the coefficients in equation, by using the FMOLS methodology.

## 4. Labor flexibility and unemployment in the long run

The panel unit root testing considers the asymptotic behavior of the time-series T and the cross-sectional dimension N. There are different tests for estimating the asymptotic behavior of the estimators for nonstationary panels. Individual unit root tests have limited power because there is a probability of finding many unit roots. The Levin-Lin-Chu test (LLC) assumes common unit root process and that the lag p varies across individuals. The null hypothesis considers that each time series contains a unit root and the alternative hypothesis is that each time series is stationary.

The empirical panel cointegration model considers four variables: unemployment rate, labor flexibility index, wages, and temporary contract labor. The LLC test results showed that for all series in levels, the null hypothesis of the existence of a unit root at a 5% level of confidence was rejected for the unemployment rate and labor flexibility index series, and failed to reject the null hypothesis for the wage and temporary labor contracts variables. However, the four variables considered were station-

## Table 4
## Panel unit root tests: individual effects estimation, N=32, T=106

| | *Method* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *LLC* | | *IPS* | | *ADF-Fisher* | | *PP-Fisher* | | *Hadri* | |
| *Variable* | *Levels* | *First diff.* | *Levels* | *First diff.* | *Levels* | *First diff.* | *Levels* | *First diff.* | *Levels* | *First diff.* |
| UR | -6,545* | -40,649* | -6,109* | -44,163* | 140,244* | 1040,34* | 113,841* | 929,35* | 23,903* | 0,626 |
| LFI | -1,440* | -12,820* | -2,193* | -29,061 | 99,465* | 829,375 | 128,118* | 943,803 | 34,619* | -2,642 |
| W | -1,047 | -32,678* | 6,023 | -35,731* | 10,228 | 1020,45* | 6,296 | 41,434* | 613,907* | -1,491 |
| TE | 0,411 | -13,662* | 1,496 | -29,483* | 61,280 | 837,093* | 6,296 | 613,907* | 82,552* | 967,966 |

Source: own elaboration.

LLC = Levin, Lin, Chu, IPS= Im, Pesaran, Shin. The statistics are asymptotically distributed as standard normal except the Fisher tests that are computed using asymptotic Chi-square distribution. * indicates the rejection of the null hypothesis of nonstationarity (LLC, Breitung, IPS) or stationarity (Hadri) at least at 5% level of significance. UR = unemployment rate, LFI =labor flexibility index, W=wages, TE = temporary contract labor.

ary in the first differences (table 4). It is worth mentioning that this test performs well with large samples (T between 5 and 250). However, a disadvantage of the test is that it assumes cross-sectional independence.

The Im, Pesaran, Shin (IPS) test allows for heterogeneous coefficients and therefore is less restrictive than the LLC. The null hypothesis of the test considers that all individuals follow a unit root process and the alternative hypothesis allows some individuals to have unit roots. The test results showed that the variables of unemployment rate, wages, and temporary contract labor rejected the null hypothesis of the existence of a unit root at the 5% level of confidence, and failed to reject the null hypothesis for the labor flexibility index variable. It is worth mentioning that the IPS test performs better than LLC for small samples.

Additionally, the ADF-Fisher, PP-Fisher and Hadri panel unit root tests were estimated. The two first tests combine the p-values from individual unit root tests, and define the null hypothesis of individual unit root tests for all cross-sections. The results rejected the null hypothesis for the first differences of unemployment rate, wages and temporary workers and rejected the null of LLC in levels. Finally, the Hadri test was estimated; this panel unit root test has the null hypothesis of no unit root in any of the series of the variables and therefore is analogous to the KPSS unit root test. The results failed to reject the null hypothesis in first differences for all the variables included in the model. Therefore, based on the tests estimated it was possible to continue with the long-run cointegration estimation of the series of the model.

### *4.1. Panel Cointegration Analysis results*

The methodology for determining the existence of a cointegrating relationship consists of four panel statistics and three group panel statistics to test the null hypothesis of no cointegration against the alternative of cointegration. Table 5 presents eleven tests divided in two sections: the panel statistics and the group statistics. In the first test, it is assumed that a first-order autoregressive term is the same across all the cross sections, while in the case of group panel statistics the parameter of the term varies over the cross sections.

In the case of panel statistics, the null hypothesis is rejected for the three variables included in the model indicating that they are cointegrated. Additionally, for the case of the group statistics, the rejection of the null hypothesis implies that at least one of the explanatory variables is cointegrated. Therefore, the Pedroni tests provided strong evidence of panel cointegration of the variables considered. Finally, to test the cointegration relationship, the Kao test (1999) was estimated. This test also

**Table 5**
**Panel cointegration tests for unemployment rate, wages, and the labor flexibility index model**

| *Pedroni residual cointegration test* | | | | |
|---|---|---|---|---|
| | | *Panel statistics* | | |
| | *Statistic* | *Prob.* | *Weighted Statistic* | *Prob.* |
| Variance-Statistic | 1,243 | 0,689 | 1,484 | 0,069 |
| rho-Statistic | -4,822 | 0 | -4,247 | 0,000 |
| PP-Statistic | -4,853 | 0 | -4,071 | 0,000 |
| ADF-Statistic | -4,494 | 0 | -3,848 | 0,000 |
| | | *Group statistics* | | |
| rho-Statistic | -3,449 | 0,000 | | |
| PP-Statistic | -3,914 | 0,000 | | |
| ADF-Statistic | -3,966 | 0,000 | | |
| Kao residual cointegration test | | | | |
| | *t-Statistic* | *Prob.* | | |
| ADF | -4,502 | 0,000 | | |

Source: own elaboration.
An individual intercept was included. Panel referred to the within dimension and group referred to the between dimension. Null hypothesis: No cointegration.

extends the Engle-Granger framework to test panel data allowing for heterogeneous intercepts and trend coefficients among the cross-sections. It runs an auxiliary regression and uses a panel-ADF statistic. In this case, the result failed to reject the null hypothesis of cointegration.

The Granger causality test was estimated for the variables included in the model. On one hand, the results with one lag rejected the null hypothesis that the unemployment rate variable does not cause the variables temporary contract workers and wages. On the other hand, the results of the test indicate that the three explanatory variables TCW, W, and LFI fail to reject the null hypothesis and therefore, there is causality from the explanatory variables with respect to the unemployment rate (Table 6). Once a linear combination of the series in the long-run is established, it is possible to run a regression of the variables considered. In order to generate long run estimates for a cointegrated panel, it is necessary to use a panel modified ordinary least squares regression to avoid endogeneity for the regressors and serial correlation and generate consistent parameters.

**Table 6**
**Pairwise Granger Causality Tests**

| *Sample: 2006M01 2013M12* | *One lag* | | *Two lags* | |
|---|---|---|---|---|
| *Null Hypothesis:* | *F-Statistic* | *Prob.* | *F-Statistic* | *Prob.* |
| TCW does not Granger Cause UR | 1,2264 | 0,2682 | 7,0718 | 0,0009 |
| UR does not Granger Cause TCW | 10,0972 | 0,0015 | 7,6501 | 0,0005 |
| W does not Granger Cause UR | 4,8935 | 0,027 | 9,1003 | 0,0001 |
| UR does not Granger Cause W | 1,6051 | 0,2053 | 56,7771 | 0,0000 |
| LFI does not Granger Cause UR | 9,5452 | 0,002 | 7,6328 | 0,0005 |
| UR does not Granger Cause LFI | 5,9410 | 0,149 | 4,7925 | 0,0084 |

Granger Causality assumes that all coefficients are same across all cross-sections. UR=Unemployment rate, LFI=Labor flexibility index, W=Wages, TCW= temporary contract workers

Source: own elaboration.

## 5. FMOLS, numerical labor flexibility and unemployment results

The government of Mexico has been implementing labor flexibility policies in the last thirty years. Particularly, the changes in the new federal law of 2012 generated the conditions for establishing temporary contracts. As a result, the numerical labor flexibility indicates that employment based on temporary contracts has had an important expansion in the last ten years, growing at a much faster rate than employment based on permanent contracts. At the regional level, numerical labor flexibility has the fastest rates of growth in large urban cities such as Mexico City and the states lagging behind in terms of economic growth.

The correlation between the labor flexibility index and the unemployment rate at the national level suggests the possibility of a positive impact of labor flexibility. Additionally, the estimations of the two FMOLS regressions corroborated the positive correlation between labor flexibility and the unemployment rate. The econometric method is useful, although it does not include a formal cointegration test. Therefore, the estimates and the significance of the coefficients are considered to validate the existence of cointegrating equations. The first model considers a cointegration equation which is deterministic, and the second model, a cointegration equation which is deterministic in a linear trend. The results of the first model showed that the labor flexibility index presented a negative coefficient, but it was not statistically significant. On the other hand, the coefficients of the wages paid to workers and temporary workers control variables were positive and statistically significant (table 7).

**Table 7**
**Panel fully modified least squares (FMOLS) estimations**

| | *Models* | |
|---|---|---|
| *Variable* | *1* | *2* |
| Labor flexibility index | -0,0043 | 0,1423* |
| | (-0,1703) | 3,919346 |
| Wages | 0,0230* | 0,0353* |
| | (16,5632) | 7,33839 |
| Temporay contract workers | -0,0000* | -0,0000* |
| | (-5,0229) | -14,23725 |
| R square | 0,6813 | 0,7932 |
| R square adjusted | 0,6776 | 0,7885 |
| Mean dependent var | 4,467416 | 4,467416 |
| S.D. dependent var | 1,666179 | 1,666179 |

t-statistics are in parenthesis. Model (1) cointegration equation deterministic is C and (2) cointegration equation deterministic is a linear trend. Unbalanced panel, N=32, T=32, observations = 2974.
* Statistically significance at 1* level.

Source: own elaboration.

Additionally, a second model, which includes a linear trend was estimated. It exhibited positive coefficients for the labor flexibility variable and was statistically significant at the one percent level of confidence. The adjusted *R* squared of this model was 0.79, signifying an acceptable goodness of fit of the model and a good approximation of the regression to the real data points.

The coefficient of the wage variable was positive and statistically significant; therefore, this result statistically supports a positive correlation between higher wages and an increasing unemployment rate. Finally, the temporary contract workers variable exhibited negative coefficients in both models. The outcome suggests that the increase of temporary workers would have a direct effect of reducing the unemployment rate.

The results of the FMOLS estimations suggest that labor flexibility, as measured by the index of temporary workers to total employment, has a positive effect on the unemployment rate. However, in the first model estimation, this relationship was not statistically significant. Therefore, there is evidence that, at least in the first 3 years after the changes in the Mexican labor law, the increasing temporary labor contracts have increased unemployment.

Overall, the expansion of workers with temporary contracts and the reduction of long-term contract workers have had the effect of increasing the unemployment rate. This is probably because of the diminishing share

of this type of workers in the Mexican labor market. Therefore, there is evidence that, at least in the first three years after the changes in the Mexican labor law, the increase in temporary labor contracts has increased unemployment.

## Conclusions

As a result of liberalization economic reforms, there has been a transformation of the labor market in Mexico that will likely intensify with the labor reform that was implemented by the government in 2012. The increase in temporary contract workers is a tangible aspect of the labor reform which is related to labor market flexibility and its analysis could be useful for evaluating the impact of labor reforms on the unemployment rate of Mexico.

The economic perspective that supports increasing labor flexibility considers that labor rigidity increases costs and that it is necessary to eliminate labor market regulations. Therefore, following this perspective, it is important to reduce long-term labor contracts and higher cost layoffs and to increase flexible work hours to boost the demand for labor as well as economic growth. However, empirical studies have shown different results with respect to the relationship between the unemployment rate and labor flexibility, depending on the different labor markets and the economic conditions at the domestic and international level.

It has been argued that the Mexican economy requires labor flexibility in order to reduce unemployment. However, it has also been argued that the Mexican economy is characterized by having both a tradable sector based on labor intensive jobs and manufacturing, and a non-tradable sector related to informal markets. Therefore, in a context where competitiveness has been based on low wages and informal markets, it is not clear what could be the potential benefits of labor deregulation in an increasingly precarious labor environment.

The paper estimated a panel cointegration model using data for permanent and temporary labor contracts, wages, and the unemployment rate. The Mexican economy has experienced an *informal* process of increasing labor flexibility since the establishment of market oriented policies. This flexibility has been characterized by an increasing share of temporary workers within the total workers with labor contracts. In particular, states with lower economic growth experienced the fastest increase in temporary contract labor. Finally, heavily populated urban regions with important manufacturing and services sectors, such as Mexico City, also showed a rapid increase in temporary workers.

In order to corroborate the long-term effect of increasing temporary labor contracts on the unemployment rate of the Mexican workers of the formal labor market, a cointegration panel model was established to corroborate whether or not there was a cointegration equation between the numerical flexibility index and the unemployment rate.

The econometric tests indicated the series did not show a unit root in the first differences and provided evidence of the existence of panel cointegration of the series considered and were supported by the Kao test that also failed to reject the null hypothesis of cointegration among the variables considered in the model.

Additionally, the results of the Granger causality indicated that the explanatory variables of the model supported the hypothesis that the explanatory variables determine the unemployment rate. The outcome provided more support to the potential information that could be generating the relationship proposed on the empirical model. The FMOLS estimations including a linear trend exhibited positive coefficients for labor flexibility variable and was statistically significant at one percent level of confidence. Therefore, the results seem to better support for the outcome where the numerical flexibility index has a positive effect on the unemployment rate.

It can be concluded that the estimations of the study contribute to the discussion of the effects of labor flexibility on employment, by supporting the empirical evidence that indicates that at least for developing economies, labor flexibility policies do not clearly improve labor employment in formal markets (Kahn, 2010) and (Gebel and Giesecke, 2011). However, for the case of Mexico, the results of this paper seem to be in concordance with the results provided by Loría, *et al*. (2015) and Di Tella, and MacCulloch (1999), which do not support evidence of the negative effects of numerical labor flexibility on unemployment. In general, an explanation for these contrasting results, as compared to other findings in developed economies, could be because of the characteristics of the Mexican labor market. An important share of the Mexican labor market is based on informal employment with low labor skills, and another part consists of formal employment which has not captured more workers from the informal markets as a result of the flexible labor regulations (Frenkel and Ross, 2004).

Finally, it is interesting to point out that the temporary contract workers coefficient was negative in both models, suggesting that the increase of temporary workers has a direct effect of reducing the unemployment rate. Hence, the most important conclusion from the models is that the increasing numerical flexibility in the Mexican economy could be affecting the levels of unemployment by affecting the labor commitment to

the acquired jobs. However, there is a positive effect in the number of temporary workers that are added to total labor employment.

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**Eduardo Mendoza-Cota**. Mexicano. Researcher of the Economics Department of El Colegio de la Frontera Norte (COLEF). He has coordinated the Applied Economics Master Program and the Economics Department at El COLEF and the Regional Economics Master Program in the Universidad Autonoma de Coahuila (2001-2004). He is professor of regional economics, economic growth and labor economics at the graduate and undergraduate level, both in El Colegio de la Frontera Norte and San Diego State University. Presently, he is a member of the National System of Researchers, level 3. He has published an important number of papers in Mexico, the USA, and Europe on the regional economic analysis of the economic integration between Mexico and the USA and the impact of migration and remittances on the economic growth of the northern border region of Mexico. He has coordinated projects related to his research specialties from which the following projects stand out: Conacyt, OECD, Social Sciences and Humanities Research Council of Canada (SSHEC), SCERP, and El Consejo Economico de Tijuana (CDT). Some of his publications are: *La crisis financiera internacional: efectos sectoriales en México y en su frontera norte*, El Colef, Tijuana, (2013); "US-Mexican Economic Integration and its effects on Unemployment in Mexico's Northern Border States", *Journal of Borderland Studie*s, 28 (1), Taylor and Francis Online, pp. 93-108 (2013); "Características y determinantes de los cambios recientes de los flujos migratorios de trabajadores mexicanos hacia Estados Unidos", *Papeles de Población*, 18 (71), Universidad Autónoma del Estado de México, Toluca, pp. 1-36 (2012).