Hysteresis in Mexico: A PANIC approach

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Abstract

Nowadays the study of unemployment rates is particularly important as a result of the unusual increase of this variable in recent years. In this way, it is essential to develop specialized and effective public policies focused on reducing this trend. This research analyses the presence of hysteresis in Mexico through the application of PANIC method (Panel Analysis of non stationarity in idiosyncratic and common components) for thirty-two states including Mexico City. The results suggest the presence of hysteresis in the common components of the series as well as in some of the idiosyncratic errors specific to each state.

Key words: Labor market, unemployment, hysteresis, unit root, and panel data.

JEL: C13, C21, E24, E60.

I. Introduction

The study of unemployment is particularly important given its economic and social implications. This analysis is even more relevant because of the inertia appreciated on the unemployment rates across the world. Poverty, emergence and growth of shadow economy, migration and even violence are related to the labor market conditions (Boeri y Garibadi, 2001; Edmark, 2005)

Hence, the high and persistent unemployment rates phenomenon has been object of study particularly after the eighties when there was an unexpected growth in such variable. Since then, theorists have questioned employment theories of convergence to a natural equilibrium rate as well as a non-accelerating inflation rate of unemployment which seem to not be consistent with the empiric evidence in recent years (Blanchard y Summers, 1986; Mitchell, 1993). In this way, it has been stated the presence of a hysteresis phenomenon over unemployment, term which in physics refers to the inability of a system to return to its initial state after an exogenous shock, once this external force was removed.

Blanchard and Summers (1986) study was the first in considering the existence of a hysteretic problem over unemployment rate in Europe labor market, in other words, the presence of an infinite memory on the unemployment time series with an increasing trend. Thus, perturbation over the economy such as unexpected movements over aggregate demand, labor market stability, factor prices, and others, may affect the long-term evolution of the unemployment rate equilibrium.

The main implications of this paradigm shift suggest that the effective unemployment rate is equivalent to the natural rate for each time realization and consequently the first one affects the long-term level of the second. This phenomenon is characterized by the permanent and pervasive effect that the transitory events have over unemployment rate, aspect that inhibits its stable evolution over time as well as it long-term convergence to a natural rate.

Despite the existence of studies focused on the behavior of unemployment in the developed countries, there is not a wide analysis for the Mexican specific case. Also, this limited research for Mexico uses indirect methods to infer the existence of hysteresis in the labor market. In such way, the investigation of the phenomenon becomes important because it provide a better view for the formulation and implementation of accurate economic policies.

From an econometric view, the hysteresis problem is equivalent to the presence of a unit rootin the time series (Romero-Ávila y Usabiaga, 2007), in other words, to the no existence of stationarity due to a variance problem. Meanwhile, form a macroeconomic perspective this implies that after a shock over the economy, the unemployment rates will take a long period of time to return to the previous levels.

The content of this paper is organized as follows: section II. includes a literature review concerning unemployment studies particularly to those related to the existence of hysteresis in the world and for the specific case of Mexico. Section III. provides an analysis of unemployment rate in Mexico; section IV. presents PANIC methodology and section V. provides empirical evidence regarding the existence of hysteresis in the country for the common components as well as for the idiosyncratic errors; finally concluding remarks. The information used has a monthly basis and corresponds to the non-seasonal adjusted unemployment rate for thirty-two states (including Mexico City), for the period between March 2005 and October 2011 obtained from the database of the Instituto Nacional de Estadística, Geografía e Informática (INEGI) of Mexico.

II. Unemployment theory

Classic theory refers to a non-accelerating unemployment rate in the short-term that will adjust the labor market according to the wages paid (Ball y Mankiw, 2002). However, Samuelson and Solow (1960) argue that such relation depends on changes over time. Also Friedman (1968) explores that once economic agents observe such inflationary variations there is a convergence to a natural unemployment rate in the long run.

The economic and social implications associated directly to unemployment rate makes of its theoretical study a fundamental matter for understanding and developing an accurate public policy. Studies made by Edmark (2005), Doyle, Ahmed & Horn (1999), Dell'Anno, Gómez-Antonio & Pardo (2007) link the emergence and growth of shadow economy, migration, violence, and poverty to the conditions observed in the labor market for some specific cases. For the specific migration case, Blanchard y Katz, 1992 argue that this factor mobilization serves as an adjustment mechanism to the labor conditions. Perkkala y Tervo (2002) identifies from a study made for Finland, that unemployment creates incentives for migration; nevertheless migration has a negligible effect on solving the problem. On the other hand, according to an analysis made by World Bank for the specific Latin American conditions, the poor conditions of the labor market encourage the emergence of shadow economy that works as an escape for people but fosters the persistence of high unemployment rates (Perry *et al*, 2007).

Since the eighties a rise in unemployment trend was detected for a number of European countries (Bean, Layard & Nickell 1986; Barro, 1988). The inertia observed in the nonemployee rate on such countries triggered the development of studies that suggest the existence of hysteresis in the labor market. The seminal paper of Blanchard and Summers (1986) was the first supposing the existence of such phenomenon and emphasizes the impact that the past of the variable has overits historical evolution. An explanation for the hysteresis problem is provided by Layard, Nickell & Jackman (1991) where they argue an exhaustion process of the labor force without job due to the continuous search of jobs, which entails a growth on unemployment rate. Another explanation is derived from market wage rigidities framed on the insider-outsider model (Lindberck & Snower, 1988) of negotiation processes between firms and employees. In addition, Pissarides (2000) developed a model of marching functions that explains delays in the achievements of optimums.

Hysteresis phenomena have been widely studied for the developed countries. There are studies that confirm the existence of such problem for some European countries (Chang, Lee and Nieh, 2005) meanwhile mixt results are found for the United States and Canada case. For example, Dolado & López-Salido (1996) applied an insider-outsider model relating productions shocks and real wages with non-employment rate concluding a strong affectation among these variables due to exogenous perturbations. A further analysis for Canada reveals mixt results; Fortin (1991) determines the existence of hysteresis (Fortin, 1989) meanwhile Cozier and Wilkinson (1991) conclude the opposite.

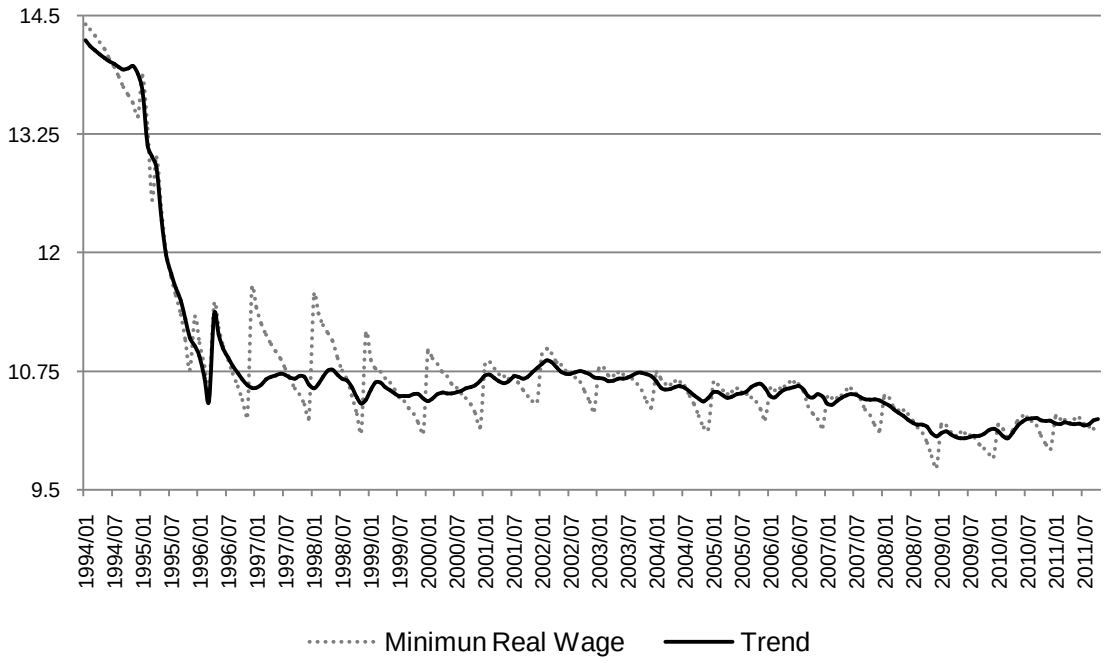
The results obtained for an OECD sample of countries for the period between 1970 and 1994 provides enough evidence of the presence a hysteretic problem for most of the countries due to the presence of a unit root over the time series. Except for the case of United States, Canada, Italy, Australia, Sweden, and Spain the other countries present an unstable behavior in such variable (Roed, 1996). Despite the evidence for developed economies, there are few studies for Latin America (Mednik, Rodriguez & Ruprah, 2008) and for the specific Mexican case.

In this way, Ruiz Hernández (1997) argues the existence rigidity on wages at state level posing the existence of hysteresis over Mexico's unemployment rate through an indirect form. Furthermore, the study of the structural problem of unemployment observed in the recent years is important as a consequence of the increase perceived. In this way, the presence of a hysterical behavior demands the implementation of an effective public policy specifically developed for the resolution of the problem.

III. Unemployment in Mexico

Unemployment can be understood as a multi causal and multifactor phenomenon which behavior is defined as a function of its historical evolution. For Salas & De Oliveira (2010) three main stages characterized the labor market in Mexico: first, an industrialization period prior to the crisis of 1929, which is distinguish for its high agricultural productivity, the development of communications and transportations services that encouraged the strengthening of the Mexican labor force promoted in part by the enactment of the 1917's Constitution. The second period corresponds to the import substitution model between 1930 a 1980 defined by an increase in the manufactures industry productivity but with a marked heterogeneity in the economic structure. The previous situation abated labor integration as a consequence of the disparity in terms of productivity and competitiveness of the different Mexican industries. The third and last period is characterized by a commercial liberalization that brought serious implications to the national industry as well as a fall of real wages as a consequence of the implementation of the economic stabilization plan framed in the debt crisis labor supply excess. This situation continues affecting Mexican society (figure 1).

Figure 1
Minimum real wages in Mexico at 1994 prices
(Pesos)



Source: Comisión Federal de Salarios Mínimos.

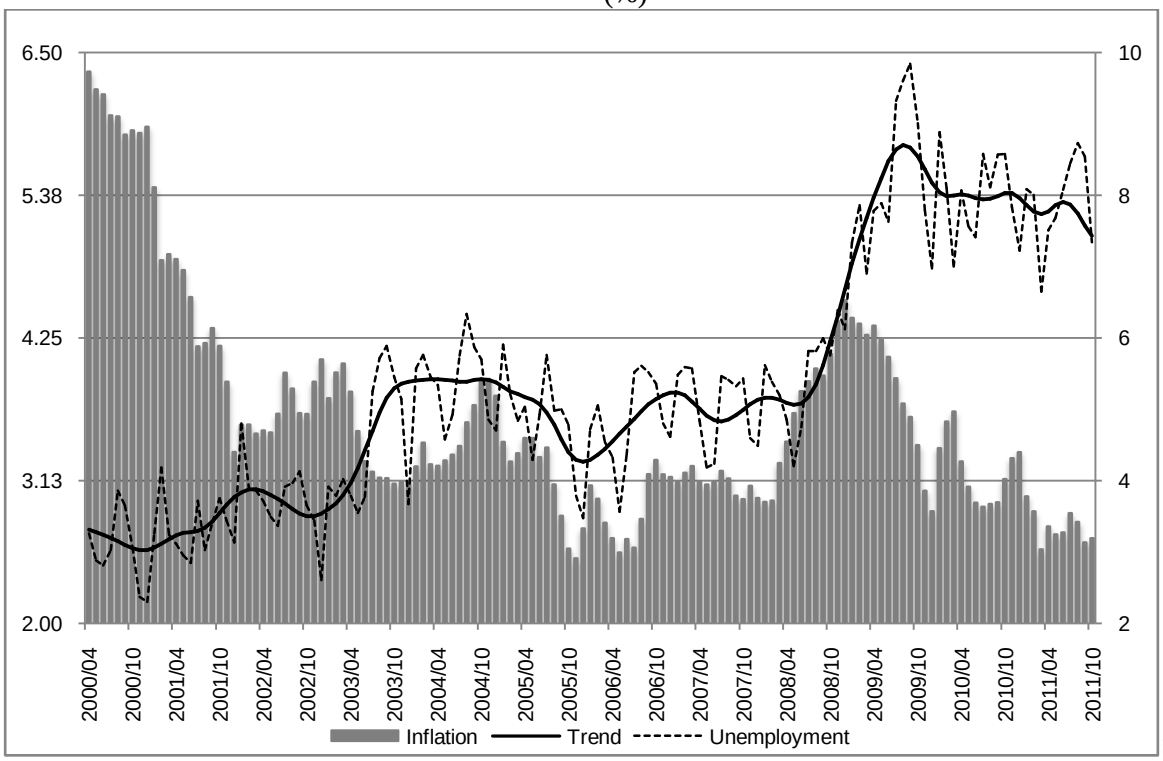
The structural reforms implemented on early eighties and focused on boosting economic liberalization had as main objective, among others, increasing employment opportunities and with that economic growth. But, does it really happen as it was supposed to? Recent empirical evidence shows that unemployment trace has not been the expected and instead this variable trend increased persistently as well as other social indicators deterioration.

An important aspect of this analysis is to understand the main causes that are contributing to the persistence in unemployment rates. Nowadays, market roll over the State interventionism exposed Mexican economy to the evolution of the international market including in such dependence labor market. In this way, the development of these variables highly depends on the performance of external sector instead of intern market strength.

Particular effects are observed over the different labor classes as a result of its lack of integration. Moore & Ranjan (2005) shows specific empirical evidence for the United Sates case in which they conclude how globalization have encourage wages inequalities between qualified and unqualified labor generating an increase in unemployment rate of the last one (Mauro & Spilimbergo, 1999).

Unemployment rate behavior in Mexico since 2000allows supposing the existence of a hysteretical phenomenon since its rise as a result of the multiple and continuous crisis has not reversed. Likewise, inflation rate in recent periods has reached a stable level contradicting classical theory postulates (figure 2). Also, such conduct can be observes in a state level analysis; Distrito Federal, México and Nuevo León, to name a few, present a similar behavior and a persistent rise trend on employment rate.

Figure 2
Unemployment rate and inflation in México until October 2011
(%)



Source: Instituto Nacional de Estadística y Geografía (INEGI).

The failure of Latin-American public policies oriented to solve unemployment problem has been studied since 1973 by Hassan whose studies pose the inability for solving structural problems. Prebisch (1970) sustains that for the period between 1970 and 1980 an economic growth superior to the 8% was necessary for generating the enough amount of new jobs for incorporating economically active population as well as for the unemployed. As a consequence, and since it is clear that Latin American countries have not reached those growing levels some other factors must be taken into account for solving the problem.

Neoclassical theory suggests through endogenous economic growth models that technological innovation, savings and investment are essential factors for reaching sustained long-term economic growth rates. Hence, the need of high saving levels as well as technology and human capital investment for the continent in order to achieve higher levels of developmentis fundamental for sustainable growth (Hassan, 1973). Given the low added value of Mexican investment as the low standard of technological innovation it becomes clear the need of specific and well design development policies following the main objective of full employment.

IV. Methodology

The conventional empiric evidence uses standard methods for the identification of units roots with the main purpose of capturing unstable patterns in the unemployment series; none the less, these statistics are less reliable when is worked with such complex variables in the structure.

Also, when using data panel for having a bigger sample, the first generation tests are not consistent when the time series are correlated due to the existence a bias that tend to reject the hypothesis (Bai & Ng, 2004).

The present study uses a unit root analysis to determine the existence of hysteresis in the Mexican unemployment rate by state.For the accomplishment of such purpose it is used the PANIC (*Panel Analysis of non stationarity in idiosyncratic and common components*) method proposed by Bai & Ng in 2004. Such technique involves the calculation of common factors for the panel by using the principal components method as well as the determination of an idiosyncratic error term for each series.

If $u_{i,t}$ represents the unemployment rate for the *i* state in *t* time $\forall i \in [1, N]$, $t \in [1, T]$. Then the stochastic form for expressing unemployment is given by the equation:

$$\Delta u_{i,t} = \kappa_i - \lambda_i u_{i,t-1} + \sum_{j=1}^{k} \alpha_{i,j} \Delta u_{i,t-j} + e_{i,t} \quad (1)$$

From (1) the stationarity hypothesis can be contrasted from the data panel bearing in mind the restrictions of the conventional unit root tests for small data samples. The analysis over the panel data is an appropriate alternative to study the stability of the series over time considering that $e_{i,t}$ is not correlated for any *i* term in any time. However, in the presence of cross-section dependence, the first-generation statistics test rejects the non-stationarity hypothesis too often.

Pesaran (2007) propose a statistic to test the existence of correlation between different levels of a panel data through the next equation:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{i,j} \right) \quad (2)$$

Where $\hat{\rho}_{i,j}$ is the coefficient two by two of the error correlation, estimated in the conventional ADF test.

In general, the assumption of independence in different levels of cross-section panel data analysis has shown to be inconsistent in empirical studies of macroeconomic variables. In this way, the first generation tests turn out to be little appropriate in presence of a high correlation between variables. Bai & Ng (2004) proposed an innovative methodology that considers and incorporates such restrictions, allowing more robust results of stationarity and cointegration tests. The PANIC method is based on the decomposition on the information in its common and idiosyncratic components. For these purposes we consider the next factorial model:

$$X_{it} = D_{it} + \lambda_i' F_t + e_{it} \quad (3)$$

Where D_{it} represents a polynomial trend function of order *p*, F_t corresponds to a $R \times 1$ vector of common factors, λ_i' is a factor-loading vector and finally e_{it} represents an idiosyncratic variable. F_t *as* well *as* e_{it} comes from an autoregressive process of order 1.

$$F_{mt} = \gamma_m F_{mt-1} + u_{mt} \quad \forall m = 1, ..., r$$

$$e_{it} = \delta_m e_{it-1} + \Im_{it} \quad \forall i = 1, ..., N \quad (4)$$

The Bai & Ng study implies that despite the integration order of the two elements in equation 3, they preserve their consistency. The estimation of the parameters is determined by applying the principal component method in order to obtain the common factors of the series. The optimum number of factors is obtained by the information criteria proposed also by Bai & Ng (2002).

A panel data with *S* variables have *S* idiosyncratic factors and a small number of common factors. The identification of stationarity hypothesis is based on the use of the conventional unit root tests on the two components and if one or more components are no stationary, then it can be concluded the existence of a hysteresis problem over the series.

The problems that are solved using PANIC method are based on the application of common factor methodology to the first differentiated data:

$$\Delta y_{i,t} = \lambda_t' f_t + z_{i,t} \quad (5)$$

Where $\hat{z}_{i,t} = \Delta e_{i,t}$; $\hat{f}_t = \Delta F_t$. Re-accumulating the estimators for avoiding the problems of over differentiation it is obtained:

$$\hat{F}_t = \sum_{s=2}^{t} \Delta \hat{f}_{m,s} \text{ and } \hat{e}_{i,t} = \sum_{s=2}^{t} \hat{z}_{i,s} \quad \forall t = 2,...,T; m = 1,...,r, i = 1,...,N . \qquad (6)$$

V. Results

For the hysteresis analysis in Mexico it was used the monthly state unemployment rate published by INEGI from March 2005 to October 2011, which include thirty-two states including Distrito Federal. First of all, is realized the cross-sectional independence test - CD test - proposed by Pesaran (2007) to identify the existence of correlation in each state. The results suggest the existence of dependence between the variables in mention (table 1).

Table1
CD Test Results

Cross Section Independence Test CD Pesaran's Test	
Statistic	39.600
P-Value	0.000
Average	0.211

The calculation of common factors was made after the previous analysis. Common factors are calculated using the differentiated and standardized time series thorough the principal components method (figures 3 to 6). The next step implies the identification of the optimum common factors to be calculated; using the eigen value method equal to one we conclude the existence of ten common factors that together explain over the seventy percent of the information. However, considering the selection criteria proposed by Bai & Ng (2002) we had identified four common factors that collectively explain 36% panel`s information of the panel information.

Common factors were re-accumulated and the Dickey-Fuller unit root test was applied to each one of them. All the factors, except for the second one, are stationary in first difference (table 2), which shows the presence of hysteresis from the common components.

Figure 3
Common Factor 1

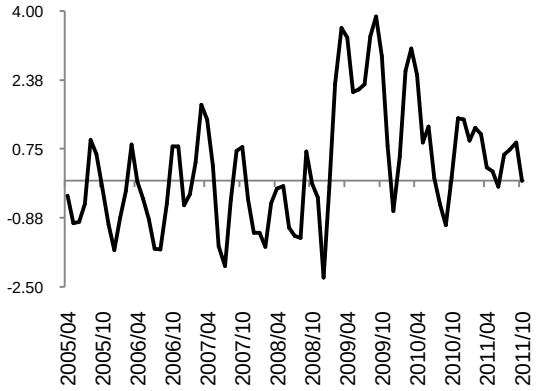


Figure 4
Common Factor 2

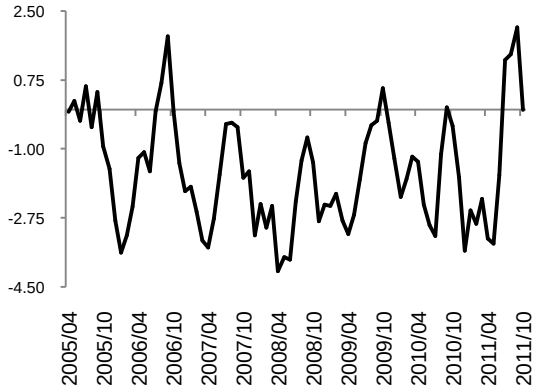


Figure 5
Common Factor 3

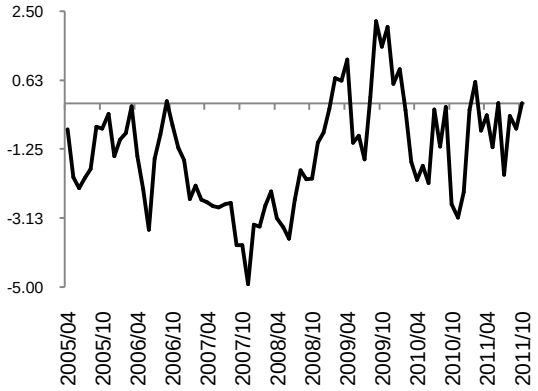


Figure 6
Common Factor 4

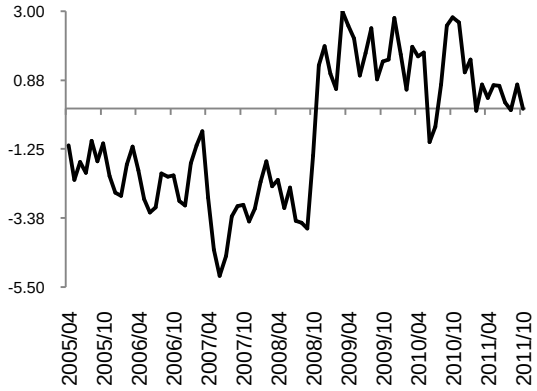


Table 2
Unit root tests in Common Factors

Factor	ADF	DF-GLS
1	-10.855 (0.0000)+	-9.605
2	-5.7549* (0.0000)+	-4.7112
3	-7.0555 (0.0000)+	-2.0706*
4	-8.4255 (0.0000)+	-7.6783

Significance level 5%
+ P-Values
* Stationary in levels

The next step involves the individual estimation of the idiosyncratic[1] error and its re-accumulation. The evaluation of the stationary tests yields the existence of unit roots in nineteen states: Aguascalientes, Baja California, Baja California Sur, Colima, Chiapas, Chihuahua, Distrito Federal, Guanajuato, Guerrero, Mexico, Morelos, Nayarit, Queretaro, Quintana Roo, Sonora, Tabasco, Tamaulipas and Zacatecas. Meanwhile, ten states are stationary in levels: Hidalgo, Jalisco, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sinaloa, Tlaxcala, Veracruz and Yucatán (table A.1). In this way, the phenomenon of hysteresis of some states is caused not only attributable to its common factor but also is consequence to their individual characteristics of each state.

VI. Conclusions

The present analysis is based on the implementation of the PANIC method for the identification of unit roots in the unemployment time series of thirty-two states of Mexico. The study considers the non-independence of these variables thought the implementation of the factorial analysis of the panel data. The results suggest three fundamental aspects. First, it cannot be rejected the hypothesis of hysteresis in the country's labor market. The previous situations lies in the fact that the evolution of such variable is unstable over time, therefore it cannot be assured the compliance of a natural unemployment rate theory in the long-term. In other words, we can conclude that the unemployment time series in Mexico take a prolonged time period to return to its trend level thorough shocks over the economy.

Secondly, it is found that this phenomenon is due to the common factors of the variable as to the individual idiosyncratic elements for each state. This is consistent to the existence of a structural problem in the Mexican labor market.

[1] The estimation of common factors was not significant for the states of Campeche, Coahuila and Michoacán

Finally, it is clear the need of the development and implementation of a public policy specially aimed for the achievement of full employment based on the increase in factor productivity through technological innovation and the investment in physical and human capital. Given the presence of unit roots in the idiosyncratic components of the states it is plausible the idea of formulating policies that addresses the specific needs of each one of them since the implementation of a national policy would be necessary but not sufficient to solve the hysteresis problem in Mexico.

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Appendix

Table A.1.
Unit root tests of idiosyncratic errors

State	$\hat{e}$	State	$\hat{e}$
Aguascalientes	-8.782 (p-value0.0000)	Morelos	-6.802 (0.0000)
Baja California	-8.759 (0.0000)	Nayarit	-7.686 (0.0000)
Baja California Sur	-6.590 (0.0000)	Nuevo León	-3.682* (0.0296)
Campeche	No significant	Oaxaca	-3.808* (0.0216)
Coahuila	No significant	Puebla	-3.804* (0.0214)
Colima	-7.429 (0.0000)	Querétaro	-3.627 (0.0000)
Chiapas	-6.254 (0.0000)	Quintana Roo	-6.215 (0.0000)
Chihuahua	-7.262 (0.0000)	San Luis Potosí	-3.946* (0.0147)
Distrito Federal	-6.415 (0.0000)	Sinaloa	-4.973* (0.0006)
Durango	-9.629 (0.0000)	Sonora	-8.095 (0.0000)
Guanajuato	-7.379 (0.0000)	Tabasco	-7.007 (0.0000)
Guerrero	-7.834 (0.0000)	Tamaulipas	-7.755 (0.0000)
Hidalgo	-4.615* (0.0020)	Tlaxcala	-3.636* (0.0334)
Jalisco	-4.094* (0.0098)	Veracruz	-4.020* (0.0120)
México	-6.081 (0.0000)	Yucatán	-3.679* (0.0297)
Michoacán	No significant	Zacatecas	-9.014 (0.0000)

Significance level 5%
* Stationary in levels