Revisiting Okun's law for Mexico: an analysis of the permanent and transitory components of unemployment and output

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"Revisiting Okun´s law for Mexico: an analysis of the permanent and transitory components of unemployment and output"

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Abstract

Unlike usual estimation techniques, we follow Clark (1989) to estimate the correlation between the transitory components of unemployment and output as part of a system of correlations between the permanent and transitory components of both series. This model provides better estimate of the Okun's Law and it takes into account the correlations that arise between the permanent and transitory components of unemployment and output within each series and across series. We find that the Okun's coefficient for Mexican economy is significantly lower than previous estimates.

JEL codes: C32, E23, E24, E32

Keywords: unobserved components, business cycles, labor market, Mexican economy

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1.- Introduction

For the last 25 years unemployment in Mexico has shown wide fluctuations with an upward trend since the early 2000s.[2] These fluctuations have coincided with output movements in the opposite direction. That is, when unemployment was below its long term trend, output was above its long term trend; whereas if it was above, output was below its respective long term trend. Moreover, these changes in the mean value of unemployment have been accompanied by changes in the unemployment volatility, indicating changes in the dynamics of the Mexico's labor market.

Previous studies about this empirical regularity, -i.e., between unemployment and output-, known as Okun's law, have estimated that a one percentage point change in unemployment induces a change somewhere between 2.3% and 2.7% in output growth.[3] These estimates represent however a puzzle for they would indicate that Mexico's labor market is as flexible as that of the United States. Yet, when looking at the different measures of flexibility, Mexico's labor market is one of the most rigid among OECD and Latin American countries.[4] In other words, the estimates found for the Mexican economy do not correspond to the dynamics found in its labor market.

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[2] In effect, during 1985-1993, open unemployment rate was on average 4.5%, while during 1994-1998 jumped to about 7%. In contrast, the rate declined during 1998-2003 to about 3%. Since 2004 the average rate increased to about 5%.

[3] See, for instance, Chavarin (2001) and Loria and Ramos (2007).

[4] For instance, according to the OECD Mexico's Employment Protection Strictness Index during the 90s and 2000s has been 3.1 compared to 0.21 for the US economy.

From a statistical point of view, these estimates have a major shortcoming: the methodology used to estimate Okun's coefficient might result in biased and inefficient estimates (Sinclair, 2009).

The usefulness of Okun's law has been pointed out by Knotek (2007) and Balakrishnan et al (2010) among others. Knotek, for instance, argues that it can be used as a simple rule of thumb to determine how much unemployment would induce "x" output growth. It can also help in forecasting unemployment rate. Balakrishnan et al, in turn, use Okun's law as an organizing framework to explain unemployment dynamics for a group of advanced countries during the latest recession.

We depart from the conventional two-step procedure to estimate the Okun's coefficient and instead follow Clark's (1989) proposal. He uses a bi-variate unobserved component model of real GDP and unemployment rate that decomposes both series into trend and cyclical components. We obtain a new estimation of Mexican Okun's coefficient and provide a proper explanation of why these estimates are reasonable or acceptable.

Some of the most important results are. First, real output and unemployment volatility are largely determined by the volatility of their permanent components (1.79 and 0.51, respectively). Second, unemployment natural rate varies over time. Third, the correlation between the permanent and the transitory components of output and unemployment is negative in both cases (-0.71 and -0.91, respectively). Fourth, there is a negative correlation between the permanent components of output and unemployment (-0.86). Fifth, the correlation between the permanent component of output and the transitory component of unemployment is positive (0.91). Sixth, the correlation between the permanent component of unemployment and transitory component of output is positive (0.92), while the correlation between the transitory components of output and unemployment is, as expected, negative (-0.67).

The paper is divided into five additional sections. The next section outlines some of the works done to estimate Okun's coefficient. In section three, we present a brief discussion about the nature of the Mexican labor market and how Clark's estimation technique can help us to have better understanding of the former's nature. In section four we describe the econometric model used to estimate the relationship between output and unemployment. Section five discusses the main results, while the last section, section six, presents some concluding remarks.

2. Okun's Law

What was originally thought to provide an estimate of the cost of unemployment on potential output has evolved into a fertile ground for discussing output's and unemployment's dynamics and how they are related. Within the Okun's literature, we identify three different strands of research: (i) Estimation of the Okun's coefficient using the conventional two-step procedure; (ii) The estimation of the Okun's coefficient as part of a bivariate model where the cyclical component is estimated jointly with trend component; (iii) Estimation of the Okun's coefficient assuming that it varies over time.

In his seminal paper, Okun (1962) estimated that a one percentage point increase in unemployment would induce a decline in output growth of about 3.3 percent. Although it has not been noted by many researchers, but the underlying assumption for getting a measure of the impact of unemployment on potential output was that unemployment rate summarizes, -or is correlated to-, the behavior of other variables such as: average hours worked, participation rates and labor productivity. In other words, unemployment "…can be viewed as a proxy variable for all the ways in which output is affected by idle resources…"(p. 2). This assumption is very important for obtaining and expecting a fixed coefficient between unemployment change and output growth.

The conventional estimation of Okun's coefficient involves a two-step procedure. The first step consists of removing the permanent component of the series, while in the second step the correlation between the transitory components of output and unemployment is estimated. The permanent component of the series is usually obtained through the use of different techniques which go from estimating the trend component by OLS, to using the Hodrick-Prescott filter. In some occasions, the unobserved permanent component has been simply eliminated by taking the first differences of the series[5]. Once the (unobserved) permanent component has been estimated, the transitory component is obtained by subtracting the permanent component from the observed series. The second step involves estimating the Okun's coefficient by OLS.

Sinclair (2009) sustains that this methodology provides biased and inefficient coefficient for two reasons. First, since the permanent and the transitory components of the two series are correlated, it is more efficient to jointly estimate the cyclical components. Second, to the extent that the measurement error of the independent variable is correlated

[5] In some circumstances when one of the series are I(0) then the first step might be redundant.

with the measurement error of the dependent variable, OLS estimates are biased and inconsistent. Thus, a better approach is to use the estimate of the correlation rather than the correlation of the estimates.

Bivariate models that estimate jointly the permanent and transitory elements of unemployment and output, on the other hand, began as a reaction to Nelson and Plosser's (1982) methodology to remove nonstationarity by first differencing, making the trend a random walk with drift rather than a straight line. Clark (1987) points out that two shortcomings of this approach are, first, tests for nonstationarity in trend have very little power against plausible alternatives; second, their analysis is based on the strong assumption that the auto-covariance function for the first difference of output is exactly zero after lag one.

Clark (1987) proposed a new analysis of the U. S. output by decomposing the series into its two unobserved independent components: the non-stationary trend and the stationary cyclical components. The framework for his analysis is the state space model which allows for a more general specification of the trend component. Clark (1989) later estimates the non-stationary permanent and stationary cyclical components of output growth and unemployment for six developed economies,[6] by using Kalman filter and Maximum likelihood. He finds strong evidence that the estimated output's stationary component is closely related to the estimated stationary component of the unemployment rate. Evans (1989), in turn, uses a bivariate VAR model to describe output-unemployment dynamics, to estimate de degree of output innovations' persistence, and to decompose

[6] These economies were: United States, Canada, United Kingdom, France, West Germany and Japan.

output into trend and cycle. He concludes that a bivariate analysis indicates the existence of feedback between unemployment and output growth as well as a negative contemporaneous correlation between output growth and unemployment innovations.

The discussion about the relationship between the transitory and permanent components of real GDP is important because it allows us to determine whether the observed GDP variability is the result of the variability of the permanent or transitory components. Furthermore, it can also help us estimate the cross series relationships between the permanent component and the transitory components.

The third strand of research about Okun's law is related to the fact that the coefficient has not remained constant over time but rather it is unstable. In effect, Knotek (2007) and Balakrishnan et al (2010), for instance, present evidence for a number of countries including the US, that the law has not been stable as previous studies suggested. Using the conventional two-step estimation procedure they find strong evidence that the coefficient has been increasing for the last decade or so. They argue that institutional changes in labor markets and technological as well as demographic changes have induced the upward trend that the coefficient shows for a group of developed countries.

As already noted, current estimates of the Okun´s coefficient for the Mexican economy put it between 2.3 and 2.7. These studies however have estimated the Okun's coefficient using the two step procedure; thus, the estimated parameters are biased and inefficient. Furthermore, these studies have limited themselves to present the estimates without giving an interpretation of what the coefficient might indicate about the nature of Mexico's labor market. The one conclusion to which these authors arrive at is that their estimates are reasonable and acceptable for they are close to the ones found for the US economy. Neither of the latter studies however provides a proper explanation of why these estimates are reasonable or acceptable. This is an important question in light of the ongoing debate about the nature of the Mexican labor market and what type of reforms are needed so that it can facilitate economic growth and improve workers' wellfare.

3. How flexible is Mexico's labor market?

Common sense would tell us that the magnitude of the Okun's coefficient is rather a reflection of the labor market dynamics. We can classify the studies about the nature of Mexico's labor market into two views. On the one hand, there is the view that Mexico's labor market is heavily regulated by laws that impede employment creation. In this case, output growth would not necessarily translate into large unemployment variations but rather into real wage changes (Heckman and Pagés, 2000 and Gill et al, 2001). Under recession and because of the rigidity of the federal labor law and unions, it would be extremely difficult for firms to lay-off workers. It is also argued that job security provisions (which includes severance payments) increases dismissal costs to the firms. These costs discourage firms to fire workers whenever there is a negative shock and reduce job creation in expansions. Heckman and Pagés (2000) found that Mexico exhibits one of the highest indexes of job security within Latin American countries, which implies that it has one of the most regulated markets in the region.[7] Thus, considering these rigidities in Mexico's labor market and that they operate during expansions as well as during recessions, one would expect a low correlation between the transitory components of unemployment and output. That is, a low Okun's coefficient.

On the other hand, there is the idea that since the mid 1980s, when Mexico began its new development strategy based on trade and economic liberalization, firms have adopted new mechanisms that let them to better adjust to economic fluctuations (De la Garza, 2005). Among these schemes there is the increased use of short term contracts and outsourcing as means to reduce labor costs that result from job stability. This is particularly true for the in-bound and service sectors, the fastest growing sectors within the Mexican economy since the late 1980s (Marshall, 2004). Within this view therefore, one would expect that Okun's coefficient be large enough so that variations in output growth would induce significant variations in unemployment rates.

Implicit in this debate is the recognition of the existence of a large informal sector which provides employment to about half of Mexican employed workers (Loayza and Sugawara, 2009). Even though informality is an unobservable variable, the size of the informal labor market has been estimated by indirect means.[8] All these indicators coincide in suggesting that informal labor market is very large, indeed.

Early studies about the relationship between Mexico's formal and informal labor markets indicated the there was a close integration between them (Calderon 2000). More

[7] OECD also found evidence that among OECD members, Mexico shows the highest Employment Protection Index for all types of contracts (permanent and temporary).
[8] For a brief description of some of these methods see Loayza and Sugawara (2009).

recent studies by Alcaraz, et al (2008) and Alcaraz (2009) corroborate the idea of a close interaction between both markets. These authors found evidence that the transition rate between formal and informal employment is higher than the one existing between manufacturing and service sectors. They point out that this higher mobility between formal and informal sectors would indicate the existence of institutional labor market rigidities in Mexico's formal sector.

The existence of a large informal labor market closely interrelated to the formal one, means that the fluctuations in output would not necessarily translate into fluctuations of unemployment, or vice-versa. In other words, the existence of a large informal labor market indicates that the relationship between the cyclical components of output and unemployment is not necessarily linear. Instead we could observe that a given change in output would induce higher labor mobility between the formal and informal sectors so that unemployment rate remains constant. Consider, for example, decomposing employment into formal (e_f) and informal (e_{inf}), then the following should be true

$$u = 1 - e_f - e_{inf}$$

That is, variations in unemployment would be soaked up by variations in formal *and* informal employment. Thus, the correlation between variations in output and unemployment would be fairly low, unless informal sector is not flexible enough. This is true even in the face of the institutional rigidities mentioned by Heckman et al. Okun himself noted that the value of the coefficient depended on a set of strong assumptions about the behavior of labor productivity, average hours worked and participation rates.

Having discussed the relationship between the transitory components of unemployment and output, there remains the question of what to expect about the relationship between the permanent components of both series. Given the existence of the different mechanisms that adds flexibility to the Mexican labor market and, more importantly, the existence of a large informal sector, we would expect that the negative correlation between the permanent components of both series would be larger than the one existing among the transitory components. The idea is that once the transitory relationships have been taken into account the economic system is viable in the long run only if some of the short run restrictions are diffused. It seems paradoxically but in the long run these changes will not be noticed.

4. A model for the output and unemployment rate.

In this section, we follow Clark's (1989) and Sinclair (2009) permanent-transitory components model for output and unemployment rate

$$y_t = \tau_{y_t} + c_{y_t}, \qquad (1)$$

$$\tau_{y_t} = \mu_y + \tau_{y_{t-1}} + \eta_{y_t}, \qquad (2)$$

$$u_t = \tau_{u_t} + c_{u_t}, \qquad (3)$$

$$\tau_{u_t} = \mu_u + \tau_{u_{t-1}} + \eta_{u_t} \qquad (4)$$

In this model, the output (y_t) and the unemployment rate (u_t) are the sum of two components. The first component $(\tau_{i_t}, i = y, u)$ is the permanent component which is the steady-state level after removing all temporary movements. The second component $(c_{i_t}, i = y, u)$ is the transitory component that expresses all temporary movements and is assumed to be stationary. Each of the trend components is assumed to be a random walk to allow for permanent movements in the series. The transitory component $\{(c_{y_t}, c_{u_t})\}$, on the other hand, is a stationary bi-variate stochastic process.

To complete the characterization of output and unemployment rates, we assume that the transitory deviations from the equilibrium values are driven by an ARMA process,

$$\begin{pmatrix} \phi_y(L) & \phi_{yu}(L) \\ \phi_{uy}(L) & \phi_u(L) \end{pmatrix} \begin{pmatrix} c_{y_t} \\ c_{u_t} \end{pmatrix} = \begin{pmatrix} \theta_y(L) & \theta_{yu}(L) \\ \theta_{uy}(L) & \theta_u(L) \end{pmatrix} \begin{pmatrix} \varepsilon_{y_t} \\ \varepsilon_{u_t} \end{pmatrix} \qquad (5)$$

Where

$$\begin{pmatrix} \varepsilon_{y_t} \\ \varepsilon_{u_t} \end{pmatrix} \overset{i.i.d}{\sim} \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2_{\varepsilon_y} & \rho_y \sigma_{\varepsilon_y} \sigma_{\varepsilon_u} \\ \rho_u \sigma_{\varepsilon_y} \sigma_{\varepsilon_u} & \sigma^2_{\varepsilon_u} \end{pmatrix} \right)$$

and the $\phi(L)'s$ and $\theta(L)'s$ are polynomials in the lag operator, L. The unobserved component model can be estimated by using state space techniques to find the likelihood function of the sample. If the error terms are assumed to be normally distributed, then the parameters of the model can be estimated employing maximum likelihood techniques. For instance, parameter estimates in the above system can be obtained by starting with an initial guess for the state vector and its covariance matrix. Given the initial estimated parameters, the Kalman filter recursively generates the prediction and updating equations. Ultimately, the Kalman filter generates both unobserved components $(\tau_{i_t}, i = y, u)$ and $(c_{i_t}, i = y, u)$.

4.1 An AR(1) transient dynamics.

Following Hua, Zivot and Creal (2007) recommendation, we started with a trend-ARMA (2, 1) model, but since we could not reject the hypothesis that θ_y=θ_u=ϕ_2y=ϕ_2y=0, our best model in term of likelihood was the trend-AR(1). To strike a balance between flexibility and model parsimony, we choose an AR (1) for the transitory component[9]. The AR (1) model is obtained from (5) by setting $\phi_y(L) = 1 - \phi_y L$, $\phi_u(L) = 1 - \phi_u L$, $\theta_y(L) = \theta_u(L) = 1$, and $\phi_{yu}(L) = \phi_{uy}(L) = \theta_{yu}(L) = \theta_{uy}(L) = 0$. The random-walk-AR (1) model implies the following moments

$$Var(c_{y_t}) = \frac{\sigma_{\varepsilon_y}^2}{1 - \phi_y^2}, \qquad (6)$$

$$Var(c_{u_t}) = \frac{\sigma_{\varepsilon_u}^2}{1 - \phi_u^2}, \qquad (7)$$

and

$$Cov(c_{y_t}, c_{u_t}) = \frac{\sigma_{yu}}{1 - \phi_y \phi_u} \qquad (8)$$

Let us look at these issues in the context of the Okun's law. Given the existence of a generalized production function, Okun suggested that there should be a strong link

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between the output gap and the employment gap. Because of the fact that the relationship is indigenously bidirectional, researchers have been juggling the equations and have regressed both output on unemployment (e.g. Freeman, 2001) and vice versa (e. g., Sögner & Stiassny 2002). Yet, the interpretation of the results frequently misguided the authors and Okun himself, which lead to spurious results.

Barreto and Howland (1993) maintained that one should seriously consider the direction of the regression. They indicate that Okun erroneously assumed that it is possible to use the lambda (λ) to derive the reciprocal coefficient ($1/\lambda$), thus being able to track the relationship in both ways. Okun was using the two coefficients interchangeably. However, the relationship between real output and the unemployment rate is not necessarily linear. Due to this fact, separate regressions should be run: output on unemployment and unemployment on output, depending on the direction in which causality runs or what link is to be analyzed. Okun's conceptual framework of this unemployment-output link can be specified econometrically as:

$$y_t - y*_t = \lambda(u_t - u*_t) + \vartheta_t \qquad (9)$$

Or

$$u_t - u*_t = \theta(y_t - y*_t) + \vartheta_t \qquad (10)$$

where $(y_t - y*_t)\, and\, (u_t - u*_t)$ are the transitory components of output and unemployment rate, respectively, and $\vartheta_t$represents a random error. The best linear predictor of the unemployment rate given output can be found by regressing unemployment on GNP (equation 10); while any attempt to predict output given unemployment requires that GNP be regressed on unemployment (equation 9).

As already pointed out, the conventional estimation of Okun's law has two drawbacks. First, if the measurement error in the independent variable is correlated with the measurement error in the dependent variable, then OLS estimates are biased and inconsistent, and since λ is negative, $\hat{\lambda}$ will tend to over estimate λ. Second, since the two components are correlated, it is more efficient to jointly estimate the cyclical components.

Therefore, in order to compare our results with more traditional estimates of Okun's coefficient, we relate the estimated moment correlations of our model with the regression coefficient λ of equation (9) through the ratio of expression (8) and (7) to get the population value of λ that should be negative given the inverse relationship between output and unemployment rate.

$$\lambda = \frac{Cov(c_{y_t}, c_{u_t})}{Var(c_{u_t})} = \frac{(1-\phi_u^2)\sigma_{\varepsilon_u \varepsilon_y}}{(1-\phi_u \phi_y)\sigma_{\varepsilon_u}^2} \qquad (11)$$

Similarly we get that

$$\theta = \frac{Cov(c_{y_t}, c_{u_t})}{Var(c_{y_t})} = \frac{(1-\phi_y^2)\sigma_{\varepsilon_u \varepsilon_y}}{(1-\phi_u \phi_y)\sigma_{\varepsilon_y}^2} \qquad (12)$$

5.- Empirical results

5.1 The Data

The key variables are unemployment and production. Mexico's gross domestic product was collected from INEGI[10], and is on a quarterly basis in real pesos (base year =2005). The unemployment series is from the Encuesta Nacional de Empleo (ENEU) and Encuesta Nacional de Ocupacion y Empleocueta (ENOE) collected by INEGI[11]. The data are representative of the urban areas in Mexico which account for about a third of the population[12]. Similar to the US Current Population Surveys, the data are from household surveys which fully describe family compositions, human capital acquisition, and experiences in the labor market. All data is quarterly, seasonally adjusted and covers time period 1987:QI through 2010:Q2.

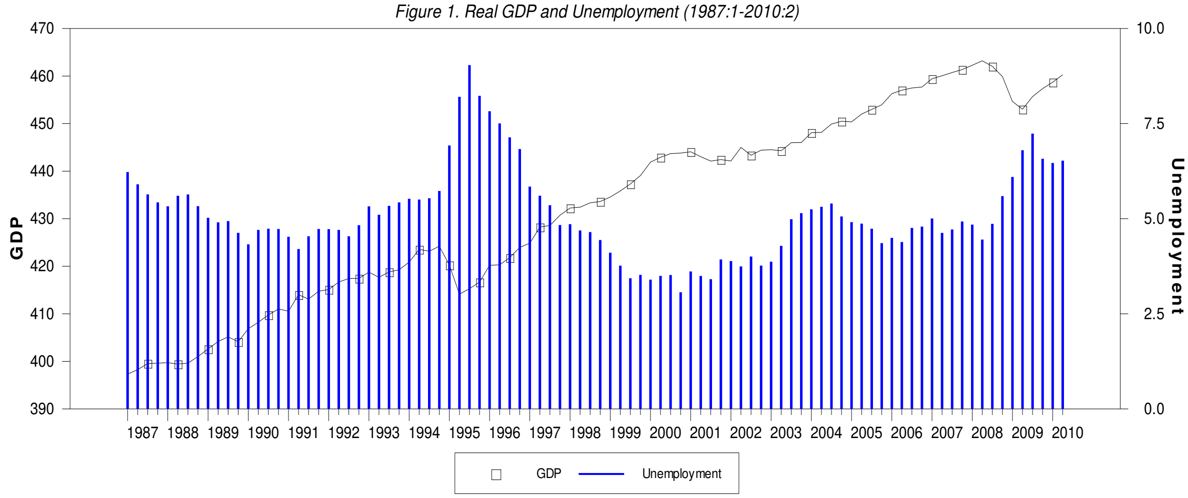
The dynamics of the variables used in the analysis are showed in Figure 1. High unemployment rates in the late 1980, and early 2000 were accompanied by relatively low and slowly growing production levels. Yet the Mexican financial crisis of 1994, and the global crisis of 2008 dramatically rose unemployment and plummeted output levels. The average rate of unemployment for the period 1987 - 2010 is about 5.09 with minimum and maximum values of 3.06 and 9.03 percent, respectively. During the early 90s the series showed a slight upward trend which reached its highest value by the end of 1995. In 1996 began a period where the unemployment rate declined rapidly, so that by the end of 2000 had reached its lowest level. This decline of the unemployment rate was short lived, however, for in the next year unemployment began a new upward trend.

[10] INEGI stands for Instituto Nacional de Estadística y Geografía and performs statistical work comparable to that done in the United States by the Census Bureau, Bureau of labor Statistics, and Bureau of economic Analysis.

[11] Unemployment data from 1987-I to 2004-4 are from ENEU standardized by ENOE criteria.

[12] Approximately 70 percent of the Mexican population lives in urban area. Moreover demographic and labor market conditions are very different across the urban and rural sectors so the results of this paper must be considered with this in mind.

Figure 1. Real GDP and Unemployment (1987:1-2010:2)



Source: INEGI.

We now turn to the estimation of our econometric model.

5.2 Stationarity test.

Before estimating the permanent and transitory components of each time series employing the unobserved component model, we need to check if the series are stationary or not. We use the Lee and Strazicich (2003) minimum Lagrange multiplier unit root test with two structural breaks. The data used are the log of real GDP multiplied by 100 (y_t) and the unemployment rate (u_t). Results of the unit root test using level data are shown in Table 1. We fail to reject the null hypotheses that there exists a unit root for each series. This implies that each time series then follows a unit root process and therefore they are not stationary in levels. This is the desired condition, so the proposed unobserved component model can be implemented.

Table 1. The endogenous two-break LM unit root test

Log (gdp). Model C: K=1, $T_{B_1} = 1994:3$, $T_{B_2} = 1998:4$, N=94, $\lambda_1 \cong 0.3$, $\lambda_2 \cong 0.5$						
Critical Values 5% (-5.74) $t_{\emptyset} = -3.009$						
Parameter	μ	d_1	d_{t_1}	d_2	d_{t_2}	ϕ
Estimator	0.7929	-4.269	-0.484	0.940	0.812	-0.188
T-statistics	3.066*	-2.829*	-0.9170	0.645	1.315**	-3.009
Unemployment. Model C: K=1, $T_{B_1} = 1995:1$, $T_{B_2} = 1999:3$, N=94, $\lambda_1 \cong 0.3$, $\lambda_2 \cong 0.5$						
Critical Values 5% (-5.74) $t_{\emptyset} = -3.058$						
Parameter	μ	d_1	d_{t_1}	d_2	d_{t_2}	ϕ
Estimator	-0.194	1.541	0.009	0.083	0.269	-0.194
T-statistics	-3.058*	4.696*	0.006	0.2545	2.823*	-3.058

*,**denotes significance at 5% and 10% respectively

$$Null: y_t = \mu_0 + d_1 B_{1t} + d_{t_1} D_{1t} + d_2 B_{2t} + d_{t_2} D_{2t} + y_{t-1} + \nu_{1t}$$
$$Alternative: y_t = \mu_1 + \gamma t + d_1 D_{1t} + d_{t_1} DT_{1t} + d_2 D_{2t} + d_{t_2} DT_{2t} + \nu_{2t}$$

Where $D_{jt} = 1\ for\ t \geq T_{Bj} + 1, j = 1,2, and\ 0\ otherwise$; $DT_{jt} = t - T_{Bj}\ fot\ t \geq T_{Bj} + 1, j = 1,2, and\ 0$ otherwise; $B_{jt} = 1\ for\ t \geq T_{Bj} + 1, j = 1,2, and\ 0\ otherwise$ and T_{Bj} denotes time period when a break occurs.

5.3 Maximum Likelihood estimates

Using the Kalman Filter, we estimate the unobserved-component model for output and unemployment rate by maximum likelihood. Table 2 reports the estimates and asymptotic standard errors while Figures 2 and 3 plots the estimated components of log of real GDP and unemployment rate respectively along with the unobserved components. They are produced using the kalman smoother, which use all information available in the sample, thus providing a better in sample fit as compared to the basic Kalman filter that only uses information available at time t. The drift (μ_y) in the permanent component of output was significant while the one in the unemployment rates was not and is not included in the report. We included a structural break in the drift term in the fourth quarter of 1994 for the log of real GDP. Some results are worth mentioning.

Table 2. Maximum likelihood estimates of the trend AR(1) model

Parameter	Estimated	Parameter	Estimated	Parameter	Estimated
Real GDP		The Unemployment rate		Cross-series correlation	
σ_{η_y}	1.7988 (0.1885)	σ_{η_u}	0.5186 (0.0564)	$\rho_{\eta_y \eta_u}$	-0.8596 (0.0479)
σ_{ε_y}	0.6733 (0.1593)	σ_{ε_u}	0.2332 (0.0389)	$\rho_{\eta_y \varepsilon_u}$	0.9149 (0.0424)
$\rho_{\eta_y \varepsilon_y}$	-0.7138 (0.1119)	$\rho_{\eta_u \varepsilon_u}$	-0.9089 (0.0454)	$\rho_{\eta_u \varepsilon_y}$	0.9175 (0.0533)
$\mu_{y_{1987-1994}}$	0.7038 (0.0970)	ϕ_u	0.2576 (0.0608)	$\rho_{\varepsilon_y \varepsilon_u}$	-0.6755 (0.0970)
$\mu_{y_{1995-2010}}$	0.6302 (0.000)				
ϕ_y	-0.0216 (0.0078)				
Log likelihood =-176.7382					

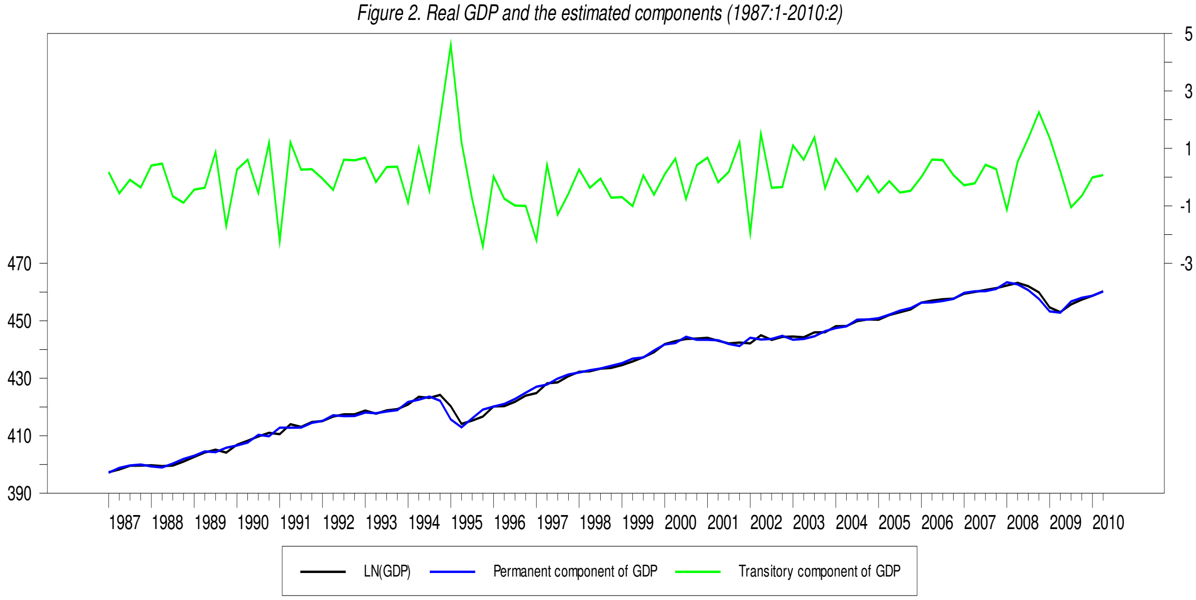
Source: own estimates.

First, innovations to the real GDP's permanent component have considerable impact and are stronger than similar shocks on unemployment's permanent component. Second, innovations to the permanent components are significantly negative correlated with innovations to the transitory components in both, real GDP and unemployment rate. Also, the estimates of the autoregressive parameters are relatively small, suggesting that most of the persistence of both series is captured in the permanent component. Figures 2 and 3 present the estimates of the permanent components of real GDP and unemployment respectively. As we can observe, most of the movements for the real GDP and unemployment rate appears to rise from permanent shocks. In particular, this result provides some support for models where the economy's movements are driven by real shocks with temporary adjustment to those shocks.

Third, the permanent component of unemployment is fairly volatile compared to the transitory component. This might be explained by a number of factors. Among these are: changes in the institutional setting; in particular, changes in labor regulation, labor mobility between formal and informal sectors, changes in participation rates and technical change and migration to the US economy[13]. From a close examination of Figure 3, we observe how at the beginning of 1994 Mexican financial crisis, the unemployment rate started to rise, but the estimates suggest that the permanent level of the unemployment rate rose faster in anticipation of future increases of the unemployment rate. We observe the same behavior at the beginning of 2001 and 2008 when unemployment's permanent component rose faster, anticipating the negative effect of the US recession on the Mexican economy.

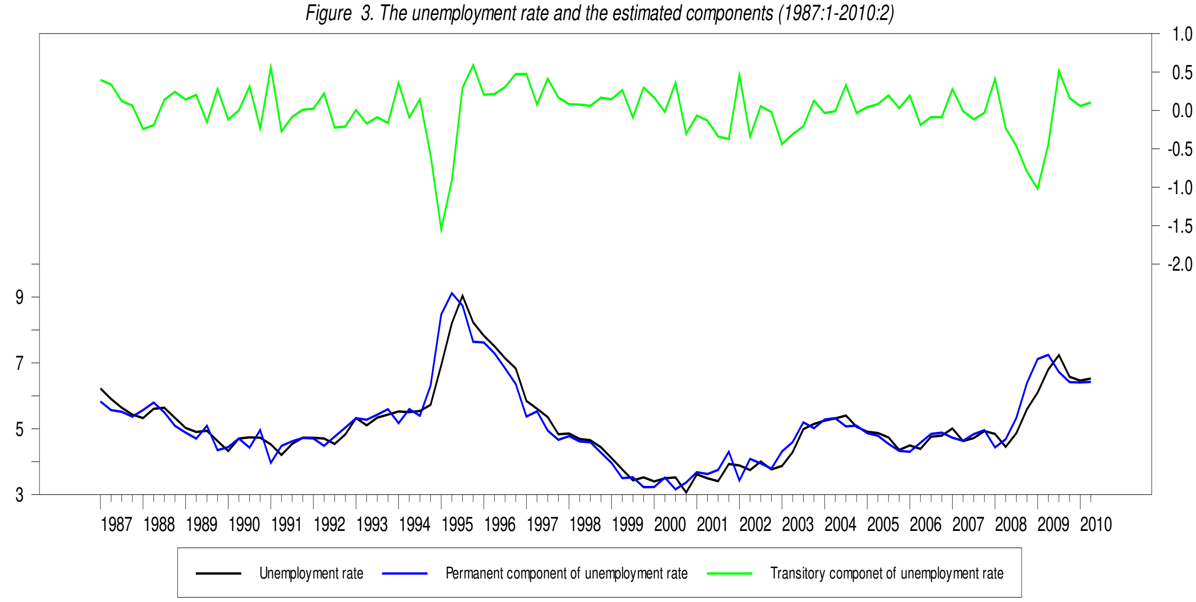
[13] The permanent component of the unemployment series is in fact the natural rate of unemployment or NAIRU.

Figure 2. Real GDP and the estimated components (1987:1-2010:2)



Fourth, as Okun's law suggests, the transitory components of output and unemployment rate are negatively correlated. Even though results presented previously indicate that most of the fluctuations in both real GDP and unemployment rate appear to be due to movements in the permanent components, it still important to consider the relationship between their transitory components for two main reasons (Sinclair, 2009): (i) If money is neutral in the long run, it is only the transitory components that can be affected by monetary policy. Therefore, understanding the relationship between these components is important for understanding the effect of monetary policy shocks on unemployment; (ii) Estimates of Okun's coefficients can be compared with others in the literature.

Figure 3. The unemployment rate and the estimated components (1987:1-2010:2)



Looking at these results in the context of Okun's law, equation (9) is relevant to answering the following question: Given a certain level of unemployment, what level of GNP should one expect under the economic conditions prevailing during the sample period? To answer this question we estimate Okun's coefficient through equation (11) to get

$$\lambda = \frac{(1-\phi_u^2)\sigma_{\varepsilon_u \varepsilon_y}}{(1-\phi_u \phi_y)\sigma_{\varepsilon_u}^2} = -1.810\ (Se{:}\,0.633)$$

Which implies that a 1% decrease in transitory unemployment correspond to a 1.8% increase in transitory real GDP.

Our estimates of Okun's coefficient (λ) is, therefore, much lower than previous ones. These latter estimates have in general been based on independently estimated transitory components providing overestimated coefficients. In what follows we provide some possible explanations for this result.

First of all, given that the Mexican labor market is characterized by the existence of a large informal sector, variations in output would not necessarily be reflected by variations in unemployment rates. Another element that can explain the low correlation between the temporary components of unemployment and output is labor migration. In effect, to extent that a large segment of unemployed workers decide to migrate to the US economy rather than stay at home, unemployment rates will not be affected for these workers will not show up in the unemployment statistics. Third, underreported revenues might bias the GDP estimates. Loayza and Sugawara (2009) showed that the size of the underground Mexican economy is about 30% of GDP, while International Labor Organization-(ILO, 1999), Schneider (2002) and Vuletin (2006) estimated that the size of Mexican underground economy during the 90's ranged from 30% to 40% of GDP employing more or less the same percentage of the labor force.

Finally, the relationship between the permanent innovations of output and unemployment rate can be examined in a way similar to traditional Okun's coefficient. Therefore, let γ be Okun's coefficient for permanent movements, we find that $\gamma = \frac{\rho_{\eta_y \eta_u} \sigma_{\eta_y}}{\sigma_{\eta_u}} = -2.98$ $(Se{:}\, 0.496)$. As expected there is a negative relationship, similar to that of transitory unemployment and output, but closer to the previous estimates of Okun's coefficient. This result should not be surprising considering that our estimates of the model suggest that most business cycle fluctuations are due to movements in the permanent components of both series.

6. ***Conclusions***

In this study we have reconsidered previous estimates of the Okun's coefficient through a bivariate model that jointly estimates the permanent and temporary components of output and unemployment. Unlike the conventional method to estimate the correlation between the temporary components of unemployment and output, this method provides unbiased and efficient estimates.

Our results indicate that the Okun's coefficient is much lower than previously thought. We argue that this is expected due to the existence of a large informal labor market which serves as a cushion to output fluctuations. Mexico's labor market exhibits however other characteristics which determine the size of the correlation between the permanent components of output and unemployment. Among these are the role played by labor legislation which makes Mexico's labor market one of the most rigid labor markets in Latin America.

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