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EXPANSIONS AND RECESSIONS IN THE MEXICAN STATES: A CLASSICAL BUSINESS CYCLES APPROACH

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RESUMEN

El objetivo de este artículo es documentar las características de las expansiones y recesiones para 17 estados de México en el periodo 1993-2006, para lo que se utiliza un enfoque de ciclos económicos clásicos. Utilizamos el índice de producción manufacturera para cada estado, como indicador del ciclo económico, debido a que es la única medida de producción mensual disponible. De acuerdo a este enfoque, analizamos asimetrías en media, volatilidad y duración, así como la sincronización de los regímenes de los ciclos económicos (expansiones y recesiones) para cada caso. Nuestros resultados indican que las recesiones son menos persistentes y más volátiles (en general) que las expansiones en la mayoría de los estados mexicanos; la evidencia de asimetrías en la media, sin embargo, es poco clara. A su vez, parece haber fuertes vínculos entre los regímenes de los ciclos económicos de los estados del norte y centro del país y entre estados con patrones similares de industrialización, aunque es difícil afirmar que existe un ciclo económico nacional.

Clasificación JEL: E31, E32, F41
Palabras clave: Regímenes de los ciclos económicos, puntos de giro, asimetrías, estados de México

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ABSTRACT

This paper aims to document expansions and recessions characteristics for 17 states of Mexico over the period 1993-2006 by using a classical business cycle approach. We use the manufacturing production index for each state as the business cycle indicator since it is the only output measure available on a monthly basis. According to this approach, we analyse asymmetries in mean, volatility and duration as well as synchronisation over the business cycle regimes (expansions and recessions) for each case. Our results indicate that recessions are less persistent and more volatile (in general) than expansions in most Mexican states; yet, there is no clear cut evidence on mean asymmetries. In turn, there seems to be strong links between the business cycle regimes within the Northern and Central regions of the country and between states with similar industrialisation patterns, although it is difficult to claim that a national business cycle exists.
JEL classification: E31, E32, F41
Keywords: Business cycle regimes, turning points, asymmetries, Mexican States

1. INTRODUCTION

The interest on the analysis of Mexican business cycles has arisen during the last decade. By using different approaches, several important stylised facts of the aggregate business cycle have been documented. For example, Agénor, *et al.* (2000), Mejía (2003a) and Torres (2002) use the growth cycles approach advanced by Kydland and Prescott (1990) to determine the variables that follow, lead or are contemporaneous to the business cycle. On the other hand, Mejía (2003b) and Oliveira (2002) follow a classical business cycle view to measure and model business cycle asymmetries. In turn, Chiquiar and Ramos (2004), Cuevas, *et al.* (2003) and Mejía, *et al.* (2005) address the analysis of specific business cycles for different economic activities.

Yet, one area that, in our view, has not received sufficient attention is the analysis of the nature of regional and state business cycles in Mexico. This is an important issue, given that specific regional cycles can differ from the aggregate one due to factors such as the structure of production, local economic policies or financial conditions, infrastructure and weather, among others.[1] In particular, the structure and size of the local economy (and its competitiveness), for example, determine its degree of integration to the national and international economies and, in that sense, the magnitude of the effects of the latter ones. Furthermore, national fiscal and monetary policies as well as technological shocks can have different effects on the local economies depending on that structure. Finally, subnational business cycles can differ as a consequence of the implementation of specific local economic policies.

Although the importance of this subject may be apparent, there are only a few papers on this area. Some of them are those of Ponce (2001) and Del Negro and Ponce (1999), who use a factor model methodology and vector autoregressions and find that national fluctuations are the main source of state fluctuations. Cuevas, *et al.* (2003), in turn, report that the cyclical fluctuations of the Southern region are largely independent, that the central states are more sensible to fiscal perturbations, especially those linked to the volatility of the international oil price, and others of idiosyncratic nature, and that the Northern states fluctuations are synchronised to the dynamics of the United States (US) economy. Recently, Erquizio (2007) has analysed the dynamics of the cyclical fluctuations of several states and has defined a coincident index for each case. Indeed, he concludes that state cycles differ from each other and with respect to the national cycle. Finally, Mejía and Mejía (2007) compare the stylised facts of the business cycle of Mexico and those of the state of Mexico by applying a growth cycles approach.

Of course, all these papers have contributed to have a better understanding of aggregate and specific cyclical fluctuations in Mexico. Yet, in general, most

[1] See, for example, Norrbin y Schlagenhauf (1988), Altonji y Ham (1990), Sala-i-Martin y Sachs (1992), Samolyk (1994) y Clark (1998) for analises of the effects of these factors.

of these papers have used the traditional methodology proposed by Kydland and Prescott (1990) or more sophisticated methodologies that are linear in essence.[2] Furthermore, several papers have criticised the linearity assumption as inconvenient to address turbulent economic episodes or structural changes (see Potter, 1999; Granger and Teräsvirta, 1993), for example, which are especially relevant in the experience of Mexico during the last three decades. As a consequence, recently there has been a re-emergence of the Burns and Mitchell's (1946) view of the business cycle. These authors point out the importance of explicitly considering the business cycle regime properties. In particular, this literature has emphasised the existence of asymmetries in mean, variance and duration between recessions and expansions. Different approaches have been proposed to characterise and model business cycle regime characteristics for different countries.[3]

As mentioned above, there are a few papers analysing state business cycles in Mexico and most of them apply linear methodologies. Thus, in this context, we attempt to contribute to the understanding of the nature of state cycles by applying a classical business cycles methodology. In particular, we use a classical business cycles approach in the spirit of Burns and Mitchell (1946) due to Artis, Kontolemis and Osborn (1997) to date turning points and analyse asymmetries between expansions and recessions in terms of magnitude, duration, and volatility. Also, we evaluate the synchronisation of the state and national business cycle regimes to have a measure of the degree of integration of the state economies to the national business cycle. To do so, we apply the aforementioned methodology to the level of monthly state manufacturing production indexes for seventeen states of Mexico over the period 1993-2006.

This paper is organised as follows. In section 2 we describe the data set and show the general characteristics of the series. In section 3 we present the

[2] The Kydland and Prescott's (1990) methodology has been criticised by Canova (1998) who argues that the nature of business cycle characteristics depend on the filter used to remove the trend.

[3] Some of these models are: threshold models (Tong, 1990), Markov-switching models (Hamilton, 1989) and smooth transition regression models (Teräsvirta, 1994). See Granger and Teräsvirta, (1993), and Potter (1999) for an overview.

methodology, while in section 4 we use it to analyse the classical business cycles of the Mexican states. Finally, we state some conclusions in section 5.

2. BASIC STATISTICAL CHARACTERISTICS

We consider the experience of the seventeen Mexican states listed in table 1. Our choice of the states was based on data availability.[4] The analysis is performed by using the monthly manufacturing production index for each state reported by the National Institute of Statistics, Geography and Informatics (INEGI) over the largest possible sample period, 1993:01-2006:02. Table 1 summarises the data using descriptive statistics and the augmented Dickey-Fuller (ADF) and the Phillips-Perron unit root tests.

The descriptive statistics show great heterogeneity in the behaviour of output across states, although output of states belonging to the same region and having a similar historical industrialisation process show closer patterns. In particular, the states that construct their industrial base in the context of the import substitution industrialisation strategy and that are placed in the centre and west of Mexico (State of Mexico, Distrito Federal, Morelos and Jalisco) have experienced lower annualised growth rates in the average, although they present a relatively low volatility (as measured by the variance of the annualised growth rates), except Puebla, which has exhibited both high average growth rates and volatility. On the other hand, Northern states linked to "maquila activities" (Baja California, Sonora and Coahuila) and recently industrialised states placed in the so-called Centre-North region (Queretaro and Aguascalientes) as well as Northern traditional industrialised states (Nuevo Leon) exhibit high average growth rates. Yet, they also have experienced very high output growth volatility, especially Aguascalientes, Baja California and Sonora.

[4] The INEGI reports monthly manufacturing production indexes for these states –which are the most important producers of manufactures– starting in 1993. These indexes contain information collected in situ, so they can be considered as good indicators of state production, and they are the unique indicator published at this time frequency.

TABLE 1

Basic statistics and unit root tests

States	Basics statistics: Annualised growth rates							
	Mean	Variance	Skewness	Kurtosis	Median	Minimum	Maximum	Normality
AGS	7.31	80.29	0.19	2.84	7.80	-14.10	31.30	0.58
BC	4.70	91.84	-0.76	2.95	7.60	-23.10	19.70	0.00
COAH	5.90	41.52	0.65	3.74	5.30	-8.80	24.10	0.00
DF	0.70	40.46	-0.03	2.04	0.70	-10.90	13.80	0.06
DGO	3.30	39.14	0.12	2.10	3.50	-8.70	17.30	0.07
JAL	1.76	28.25	-0.29	2.56	2.44	-11.28	13.34	0.21
MEX	2.00	41.16	-0.32	3.48	2.10	-16.10	17.30	0.14
MOR	0.89	85.12	-0.34	2.58	1.34	-21.32	20.02	0.14
NL	4.17	28.96	-0.37	2.68	4.58	-9.36	14.33	0.14
PUE	5.74	116.33	0.03	3.81	5.60	-20.76	41.63	0.13
QRO	6.10	43.53	0.15	2.55	6.30	-8.82	22.69	0.42
SLP	3.38	52.85	-0.53	2.67	4.51	-15.06	16.10	0.03
SIN	2.42	30.83	-0.24	2.47	2.78	-10.90	14.77	0.21
SON	2.66	83.27	-0.08	2.76	2.90	-16.67	26.41	0.77
TLAX	3.57	56.59	0.27	2.84	3.70	-14.02	24.18	0.37
VER	1.56	19.13	-0.01	3.74	1.37	-12.83	13.52	0.19
YUC	4.17	33.83	-0.70	3.00	5.34	-14.54	15.31	0.00
NAL	3.04	27.04	-0.22	2.47	3.47	-9.88	13.06	0.23

TABLE 1

(Continued)

States	Levels (logs)				Differences (logs)			
	DFA		PP		DFA		PP	
AGS	-2.32	0.42 (1)	-3.16	0.10 (5)	-17.37	0.00 (0)	-17.05	0.00 (5)
BC	-1.42	0.85 (5)	-1.38	0.86 (4)	-4.32	0.00 (4)	-15.15	0.00 (6)
COAH	-1.71	0.74 (1)	-1.9	0.65 (2)	-15.41	0.00 (0)	-15.74	0.00 (5)
DF	-1.21	0.91 (0)	-1.09	0.93 (5)	-13.96	0.00 (0)	-13.95	0.00 (5)
DGO	-1.97	0.61 (1)	-2.17	0.5 (2)	-14.96	0.00 (0)	-15.10	0.00 (3)
JAL	-15.02	0.00 (4)	-1.15	0.92 (3)	-15.05	0.00 (0)	-1.03	0.94 (1)
MEX	-1.9	0.65 (5)	-1.47	0.84 (2)	-4.44	0.00 (4)	-13.88	0.00 (3)
MOR	-2.64	0.26 (0)	-2.54	0.31 (4)	-10.29	0.00 (1)	-13.65	0.00 (9)
NL	-1.85	0.67 (11)	-1.53	0.82 (5)	-3.02	0.04 (10)	-14.09	0.00 (6)
PUE	-2.1	0.54 (3)	-3.97	0.01 (7)	-10.3	0.00 (2)	-17.78	0.00 (3)
QRO	-1.29	0.89 (13)	-1.57	0.8 (1)	-2.29	0.18 (13)	-16.25	0.00 (2)
SLP	-2.13	0.52 (1)	-2.44	0.36 (5)	-13.93	0.00 (0)	-13.90	0.00 (4)
SIN	-5.05	0.00 (3)	-5.22	0.00 (0)	-15.81	0.00 (0)	-17.49	0.00 (10)
SON	-1.85	0.68 (0)	-1.87	0.67 (3)	-12.28	0.00 (0)	-12.28	0.00 (6)
TLAX	-1.78	0.71 (0)	-1.72	0.74 (2)	-12.85	0.00 (0)	-12.85	0.00 (0)
VER	-2.5	0.33 (2)	-3.4	0.06 (6)	-12.16	0.00 (1)	-17.15	0.00 (1)
YUC	-1.13	0.92 (10)	-2.18	0.50 (2)	-4.25	0.00 (10)	-18.65	0.00 (14)
NAL	-1.76	0.72 (4)	-1.46	0.84 (7)	-4.56	0.00 (2)	-11.90	0.00 (7)

Normality corresponds to *p*-values of the Jarque-Bera's conventional test. The unit root tests correspond to the *t* statistic, the *p*-values and the lag length (in parenthesis).

The range of the annualised growth rates, in turn, also shows a great volatility. We observe that the difference between the maximum and the minimum values are large, in general. The lowest value for this statistic is between 23 and 24 percentage points for Nuevo Leon, whilst the greatest one is above 62 points and corresponds to Puebla, which has also the highest variance in the sample. Some other states with high values are Sonora, Aguascalientes, Baja California and Morelos, which also have large values for the corresponding variances.

It is important to highlight that basic statistics can give us some preliminary information about the existence of asymmetric characteristics in the dynamics of the series. Important authors like Mitchell (1927) and Keynes (1936) called the attention to these features of the data describing the business cycles.[5] The claims of Mitchell and Keynes imply that economic downturns are brief and severe, whereas upturns are longer and more gradual. DeLong and Summers (1986) have pointed out that this implies the existence of a significant skewness in a frequency distribution of the growth rates of output (that is, the distribution should have significantly fewer than half its observations below the mean) and the median output growth rate should exceed the mean by an important amount. In addition, they indicate that when the kurtosis is significant there may be important outliers.[6] These statistical properties of asymmetry can be evaluated with the information presented in table 1.

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[5] For example, Mitchell (1927, p. 1) claimed that "the most violent declines exceed the most considerable advances ... Business contractions appear to be a briefer and more violent process than business expansions", whilst Keynes (1936, p. 314) argued that "... the substitution of a downward for an upward tendency often takes place suddenly and violently, whereas there is, as a general rule, no such sharp turning point when an upward is substituted for a downward tendency".

[6] For a symmetrical distribution about its mean, the skewness is zero and for a symmetrical (unimodal) distribution, the mean, median and mode are equal. A distribution is negatively skewed if the left tail is longer. Then, mode > median > mean. A peaked curve is leptokurtic, as opposed to a flat one (platykurtic), relative to one that is mesokurtic. The kurtosis for a mesokurtic curve is 3. Skewness can be measured by the third moment divided by the cube of the standard deviation. Kurtosis can be measured by the fourth moment divided by the standard deviation raised to the fourth power (see also Salvatore, 1982).

In general, the information does not reflect the existence of asymmetries of the kind suggested by DeLong and Summers. First, we observe that the largest annual downturns are more severe than the largest yearly upturns –which can be inferred from the fact that the minimum annualised growth rate value is greater than the maximum annualised growth rate value in absolute terms– only in the cases of Baja California and Morelos. Second, consistently with the claims of DeLong and Summers, the skewness is negative in 11 (out of 17) cases. Also, the median is greater than the mean for 13 states (out of 17). Yet, in the latter this difference is greater than 1 percentage point only for Baja California. Furthermore, there is excess of kurtosis only in four cases; in all the other cases the distribution of the growth rates are platykurtic. These results are consistent with those corresponding to the national information: there is a low negative skewness, the median is slightly greater than the mean and the distribution is platykurtic. Thus, the evidence does not suggest the existence of generalised asymmetries in the dynamics of state manufacturing production, at least of the kind suggested by DeLong and Summers. Yet, a more formal method will be used below.

A more complete picture of the dynamics of the manufacturing production of the states in study requires further information. After the publication of the paper by Nelson and Plosser (1982), it has become a common practice to analyse the nature of the trends of the series under study. Essentially, it is important to determine whether or not an economic series can be characterised by a process with a unit root –named integrated of order 1, I(1)–, which implies that such a series is non-stationary rather than stationary or I(0) (possibly around a deterministic trend).

We apply the conventional ADF and the PP unit root tests to evaluate whether the levels of the logarithm of the series are stationary around a deterministic trend or whether the first difference of the logarithms are stationary around a constant level (see Banarjee, *et al.*, 1993, Chapter 4). Because under the null hypothesis the asymptotic distribution of the relevant estimated coefficient is not Normal, traditional test statistics are not valid. Then, the relevant *t*-statistic has to be contrasted with the critical values, corresponding to each model, presented in MacKinnon (1996).[7]

[7] In practice, the test statistic and the *p*-values reported by the EViews 5.1 software are used.

The results for the logarithm and the first difference of the manufacturing production index for each state are also shown in table 1.[8] There is no evidence to reject the null hypothesis of a unit root in most cases. Only for Sinaloa and Jalisco there is evidence of stationarity (around a trend) according to the ADF test and for Sinaloa and Puebla on the basis of the PP test at 5% of significance. Given that the PP test is valid in more general conditions, we can accept that the production of Sinaloa and Puebla may be stationary around a trend. Consequently, it can be concluded that in general the variables in levels are not stationary around a deterministic trend or, equivalently, that they have stochastic trends. In strictly statistical terms, this means that the current shocks experienced by the series accumulate over time, which forces the series to go away from the trend. This implication is especially important because it offers evidence of the permanent nature of the effects of current fluctuations on the long-run behaviour of the economy.

Because in most cases there is no evidence to reject the null of a unit root in the levels of the series, we then test whether the first difference is I(1). The results are shown in table 1 as well. The previous considerations about the critical values and number of lags used are also valid in this case. The results suggest that this transformation is stationary or, equivalently, that the level of the variables is difference stationary or I(1) in general. This result implies that the first difference of the logarithm of the variables fluctuates around a constant mean, which can be zero.[9]

3. CLASSICAL BUSINESS CYCLES

In this section we outline the basic concepts of the classical business cycles approach and present the methodology to date the turning points –and the

[8] As usual, lags of the differenced variable were introduced to remove autocorrelation. The number of lags was determined according to the Akaike information criterion for the ADF test. In the case of the PP test, the suggested value for the truncation parameter was adopted; also, different values were tried and the implications of the results did not change.

[9] The only exceptions are Queretaro and Jalisco on the basis of the ADF and PP tests, respectively.

corresponding regimes– of the business cycles.[10] As mention above, we use the methodology advanced by Artis, Kontolemis and Osborn (1997, hereafter AKO), which follows the spirit of Burns and Mitchell (1946). The main advantage of the AKO methodology is that it generates turning for the United States economy very close to those of the National Bureau of Economic Research (NBER) and it is based only on a univariate analysis whereas the NBER's dating process is based on the analysis of different series according to distinct methodologies.[11]

3.1 CONCEPTS AND METHODOLOGY TO DATE TURNING POINTS

AKO use a classical business cycle approach in which periods of expansion and recession are represented in the level of activity.[12] From the evidence presented above, this practice is justified on the basis of three considerations. First, after the paper of Nelson and Plosser (1982), increasing evidence has accumulated about the existence of stochastic trends, which implies that the trend reversion property no longer holds. Second, it has been shown that different de-trending methods may yield different growth cycle chronologies (Canova, 1998), and that commonly used de-trending methods may induce spurious cycles (King and Rebelo, 1993 and Osborn, 1995). Third, the alternative methodology of growth cycles implies cycles that are more symmetric in duration and amplitude than the approach applied in this paper (see also Mejía-Reyes, 2003b).

Given that the regimes of the cycle are inferred primary from the level of economic activity and following to Boldin (1994), we can define the turning points as follows: a *peak* refers to the period immediately preceding a decline in real activity, or *recession*, while a *trough* refers to the period immediately

[10] This section is based on Mejía (2004).

[11] The NBER is an organisation with a long tradition in the analysis of US business cycles. See Moore and Zarnowitz (1986) and Boldin (1994) for a brief description of the decision procedure to date turning points of this organisation.

[12] This approach contrasts with the alternative growth cycles approach in which periods of "expansion" and "contraction" are represented as cyclical movements around a trend.

preceding an upturn, or *expansion*. In turn, the *period* or *duration* of a cycle is the length of time required for the completion of a full cycle and may be measured by the time between two successive peaks or two successive troughs.[13] Finally, *the amplitude of a phase or regime* refers to the magnitude of the variation of output between two successive turning points.

The methodology used in this paper, and detailed in Artis, *et al.* (1997), can be summarised in the following steps. In step one, extreme values are identified and replaced because we are interested in looking for broad upward and downward movements and we do not want these values to influence the procedure.[14] In step two, original values are smoothed by using a centred moving average of seven periods to reduce the importance of short-run erratic fluctuations. Turning points are tentatively defined in this smoothed series by the identification of points higher (peaks) or lower (troughs) than twelve periods on either side, with peaks and troughs required to alternate. In step three, we return to the unsmoothed series and use similar rules to identify tentative turning points, with the additional requirements that the amplitude of a phase be at least as large as one standard error of the monthly log changes and the duration of a cycle be at least fifteen months. The final stage compares the two sets of tentative turning points: when there is a close correspondence between the two sets of tentative turning points (± 5 months), the existence of a turning point is confirmed and dated as that identified in the unsmoothed (original) series.

3.2 MEASURING SYNCHRONISATION OF BUSINESS CYCLE REGIMES

To measure the *synchronisation between the regimes* of the business cycle we also follow AKO and adopt a non-parametric procedure that ignores the

[13] It is important to emphasise that we will consider a decline as a recession only when an identified peak precedes it and we will consider an upturn as expansion only when it is preceded by a trough. Otherwise, we will talk just about downturns or declines and upturns or revivals, respectively.

[14] An extreme value is defined as that whose (log) change compared with both adjacent observations is greater than 3.5 standard errors of the (log) differenced series; extreme values are replaced by the arithmetic average of the two corresponding adjacent observations.

magnitude of the change in the level of the series and considers only the direction of the underlying movements implied by the turning points chronologies previously defined. By doing so, we are able to measure the extent to which the cycles uncovered are contemporaneous phenomena.

Thus, the classical business cycle chronologies are used to create a binary time series variable for each state, denoting periods of expansion by zeros and periods of recessions by ones. For a pair (state *i*, state *j*) over the sample period, we obtain a 2 x 2 contingency table recording expansions/recessions frequencies. The possible combinations of regimes are shown in table 2.

TABLE 2

Contingency table for business cycle regimes

			State *j*	
		Expansion	Recession	Subtotal
	Expansion	n_{00}	n_{01}	$n_{0.}$
State *i*	Recession	n_{10}	n_{11}	$n_{1.}$
	Subtotal	$n_{.0}$	$n_{.1}$	N

The information of this table will allow us to measure the association between the classical cycle regimes of different pairs of states by using the a variant of the conventional contingency table statistic named the Pearson's corrected contingency statistic (expressed as a percentage and ranging between 0 and 100). This coefficient, CC_{corr} is defined as follows:[15]

[15] AKO find that independence of classical business cycle regimes is strongly rejected in favour of the alternative hypothesis of association for almost all pairs of countries they consider. Furthermore, they argue that Pearson's contingency coefficient is related to a conventional correlation coefficient for continuous data, but for a finite dimension contingency table it suffers from the disadvantage that the maximal attainable value is determined by the dimension of the table (see Kendall and Stuart, 1973, p. 577). Thus, the maximal value for the conventional Person's coefficient for a 2 x 2 table is $\sqrt{0.5}$. Then, they use this corrected version.

$$CC_{corr} = \sqrt{\frac{\hat{\chi}^2}{N + \hat{\chi}^2}} \frac{100}{\sqrt{0.5}} \quad (1)$$

where

$$\hat{\chi}^2 = \sum_{i=0}^{1} \sum_{i=0}^{1} \frac{[n_{ij} - n_{i.}n_{.j}/N]^2}{n_{i.}n_{.j}/N} \quad (2)$$

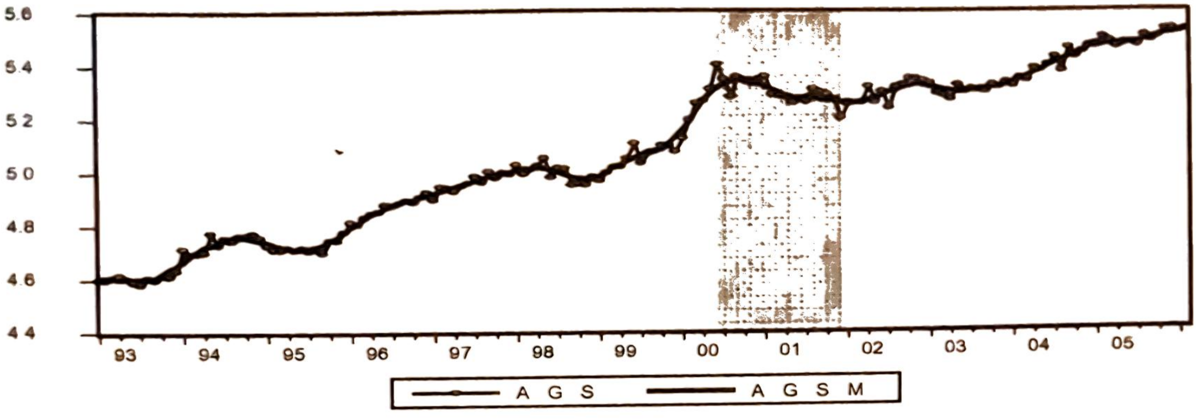
where n_{ij}, for $i, j = \{0,1\}$, represents the number of periods at which both states are in recession, expansion, recession and expansion, or expansion and recession, and N is the total number of observations. The interpretation of the corrected contingency coefficient as a correlation measure is straightforward. If the two binary variables are independent and $n_{ij} = n_{i.}n_{.j}$, then CC_{corr} equates zero. With complete dependence, that is with $n_{ij} = n_{i.} = n_{.j.}$, it can be shown that $CC_{corr} = 100$. For the subject analysed in this paper, independence implies that there is no contemporaneous relationship between the business cycle regimes (expansion/recession) for the two states. At the other extreme, complete dependence indicates that the two states are in the same regime for every time period and hence they have identical business cycle turning point dates (see Artis, *et al.*, 1997 for further details).

4. EMPIRICAL RESULTS

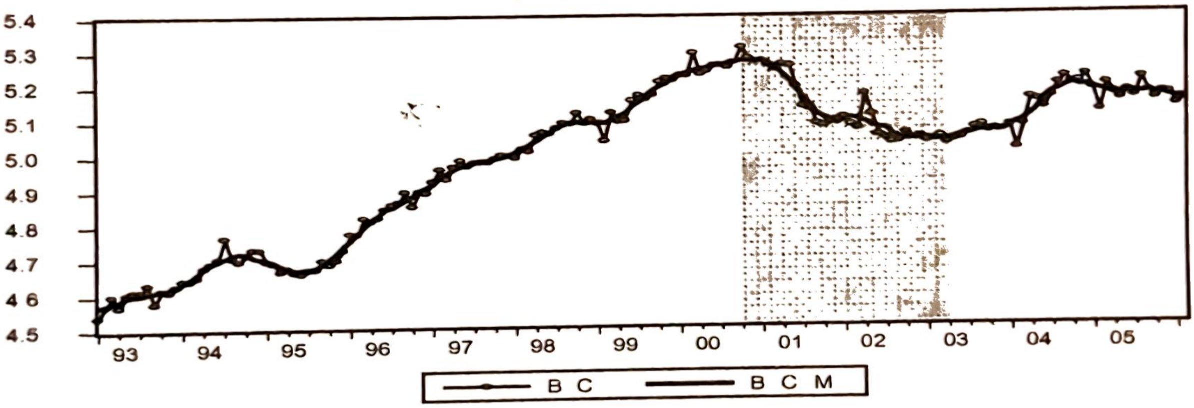
4.1 TURNING POINTS AND BUSINESS CYCLE REGIME CHARACTERISTICS

The methodology described above was applied to date the turning points of the seventeen states under consideration and the national economy by using the manufacturing production index for each. The logs and the smoothed transformation of the series are shown in graphs 1 to 18.

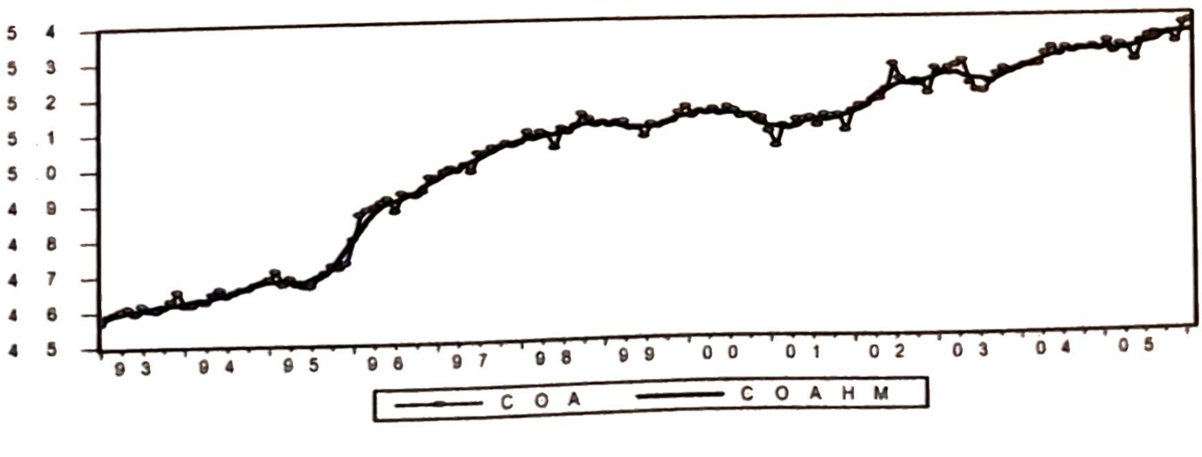
GRAPH 1
Aguascalientes



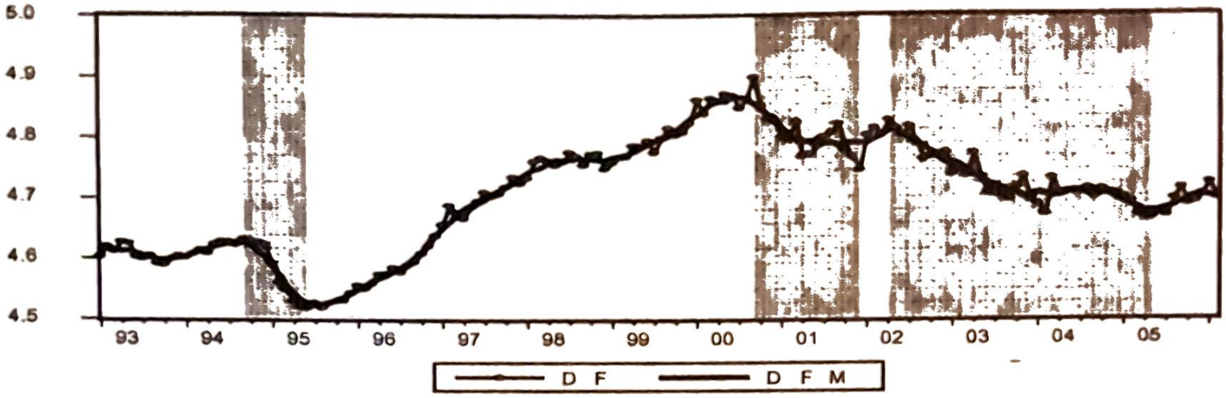
GRAPH 2
Baja California



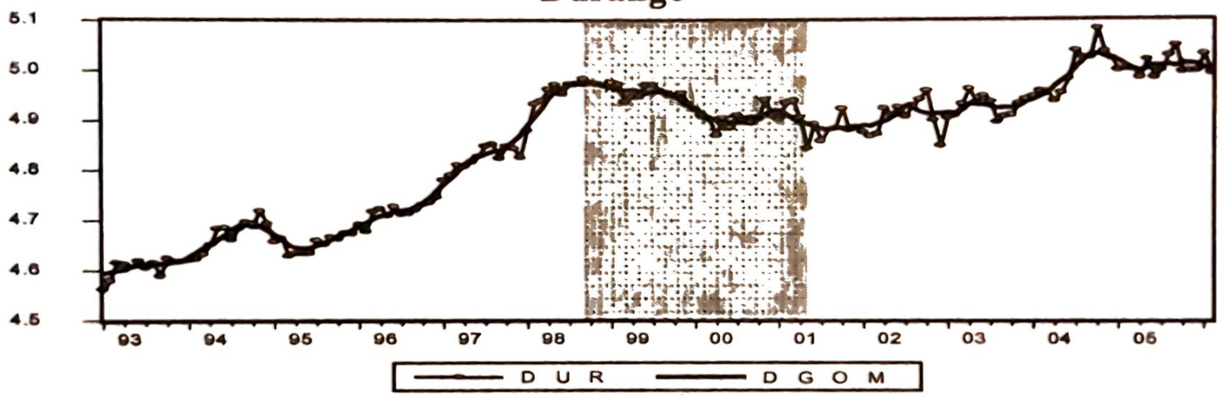
GRAPH 3
Coahuila



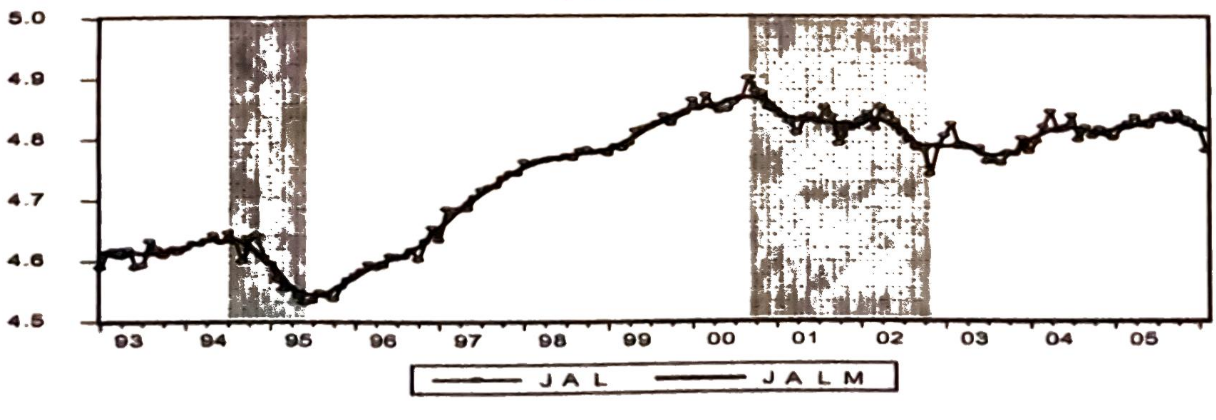
GRAPH 4
Distrito Federal



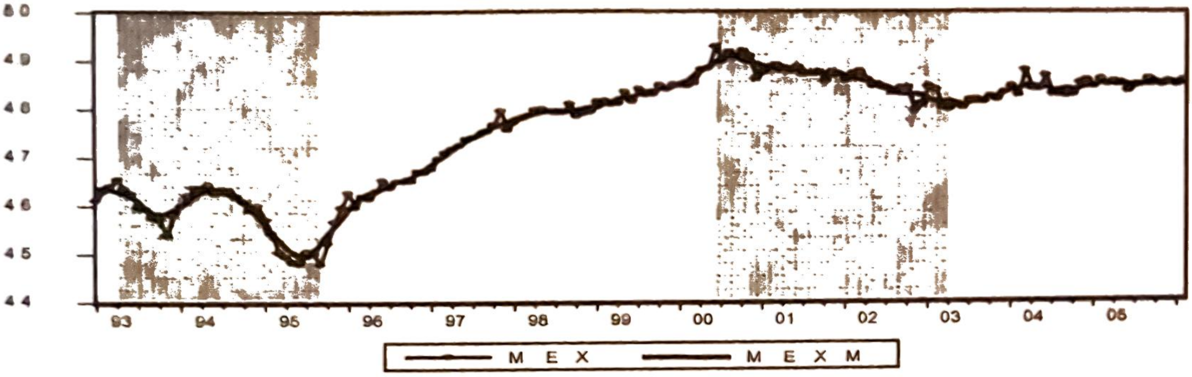
GRAPH 5
Durango



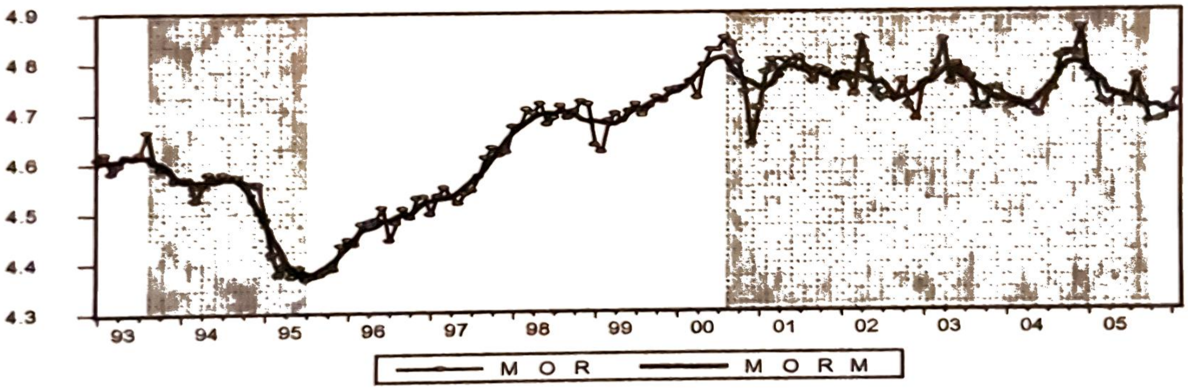
GRAPH 6
Jalisco



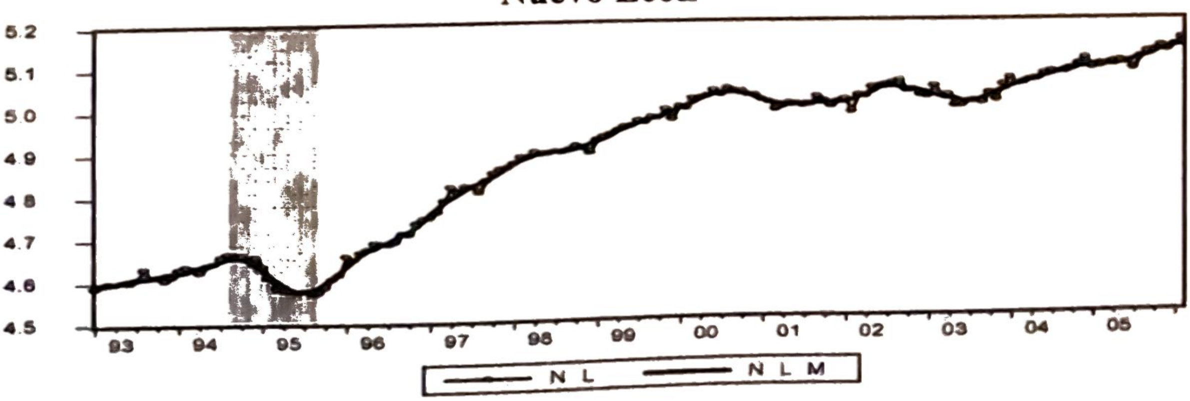
GRAPH 7
Mexico



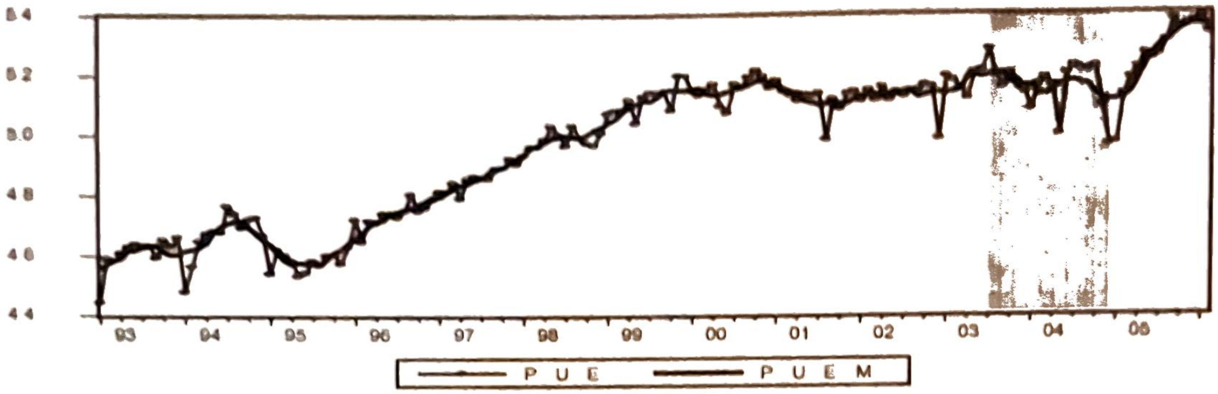
GRAPH 8
Morelos



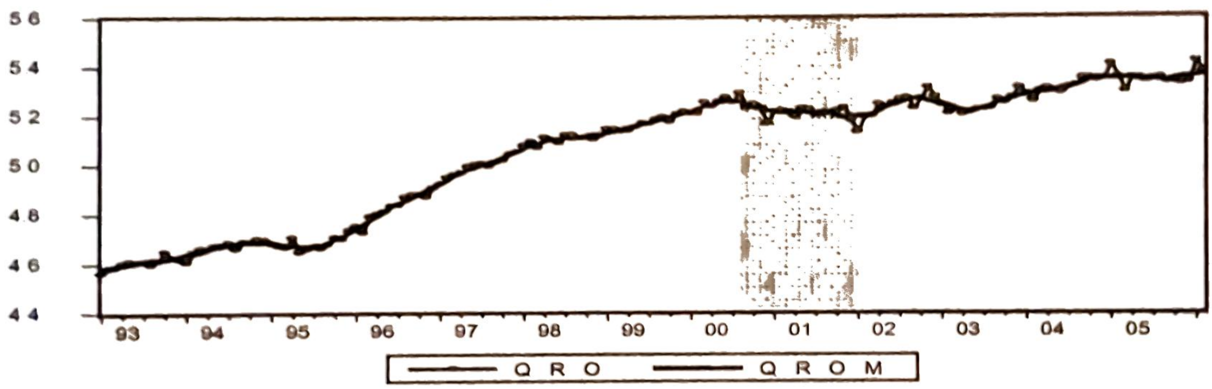
GRAPH 9
Nuevo Leon



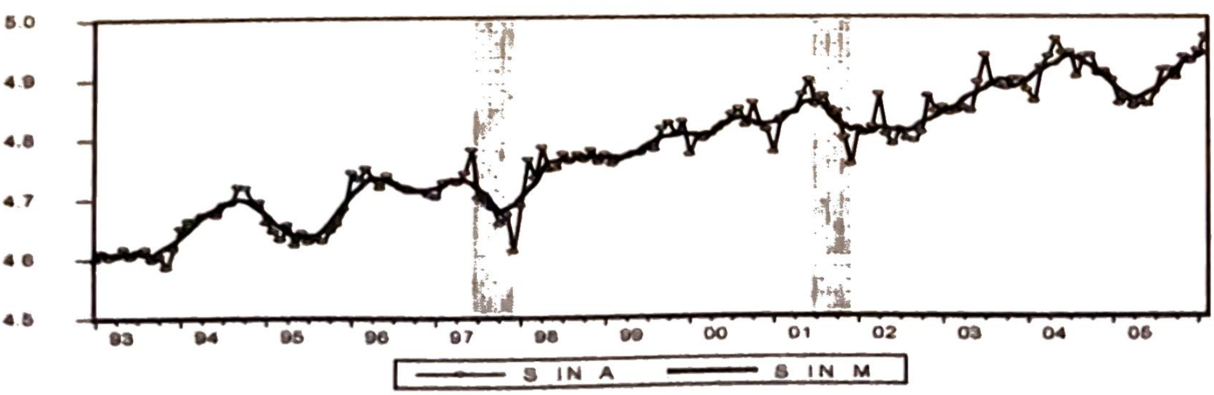
GRAPH 10
Puebla



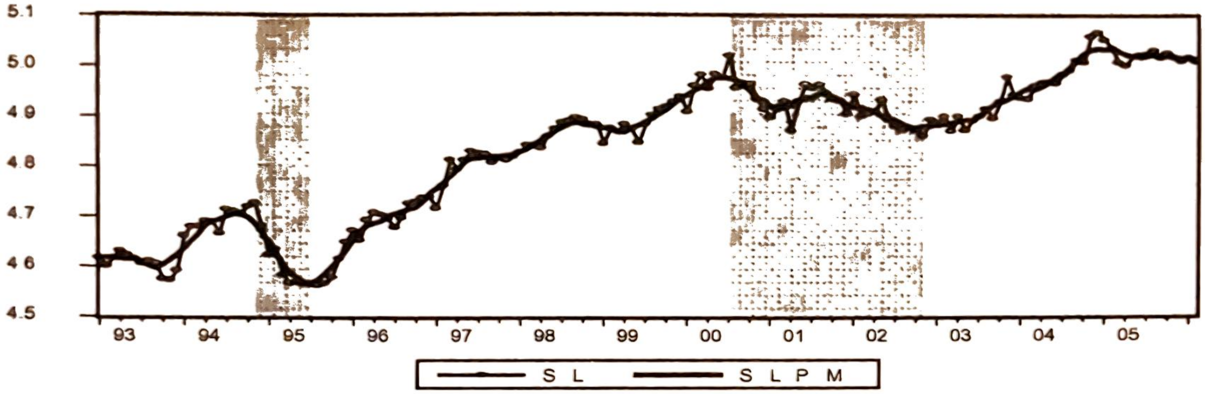
GRAPH 11
Queretaro



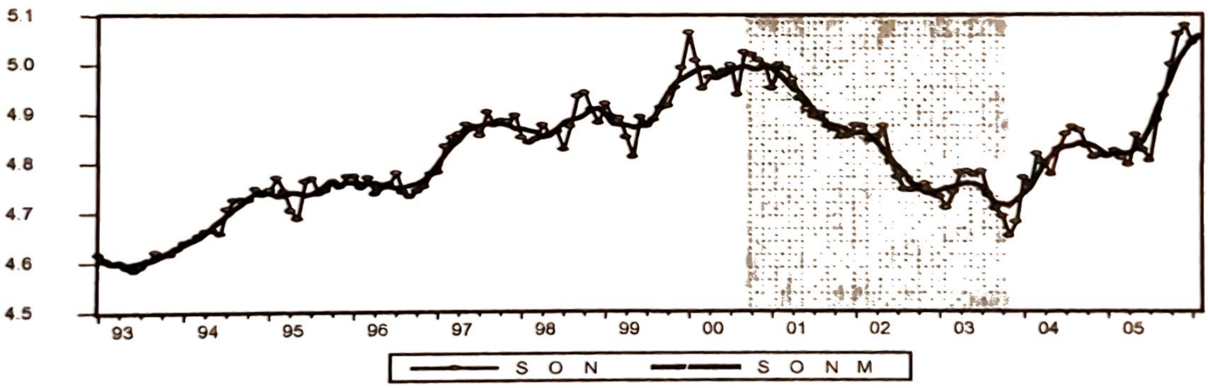
GRAPH 12
Sinaloa



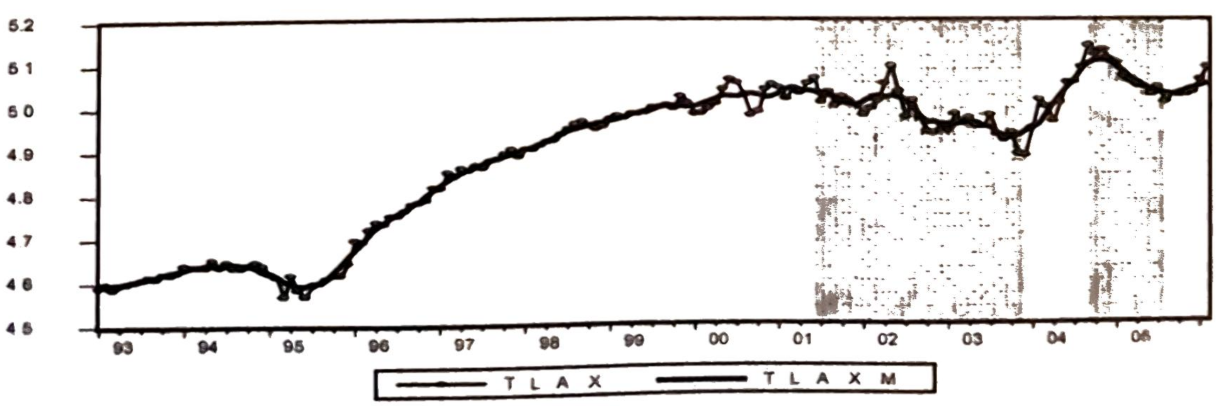
GRAPH 13
San Luis Potosi



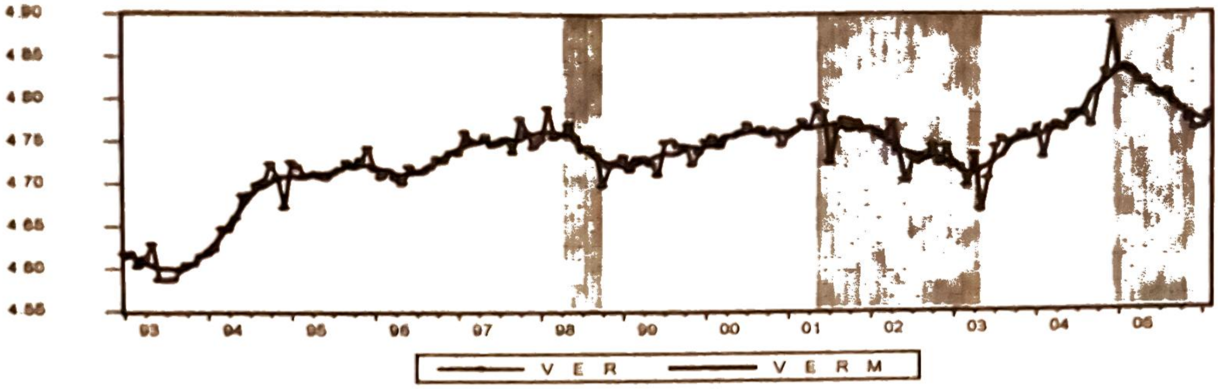
GRAPH 14
Sonora



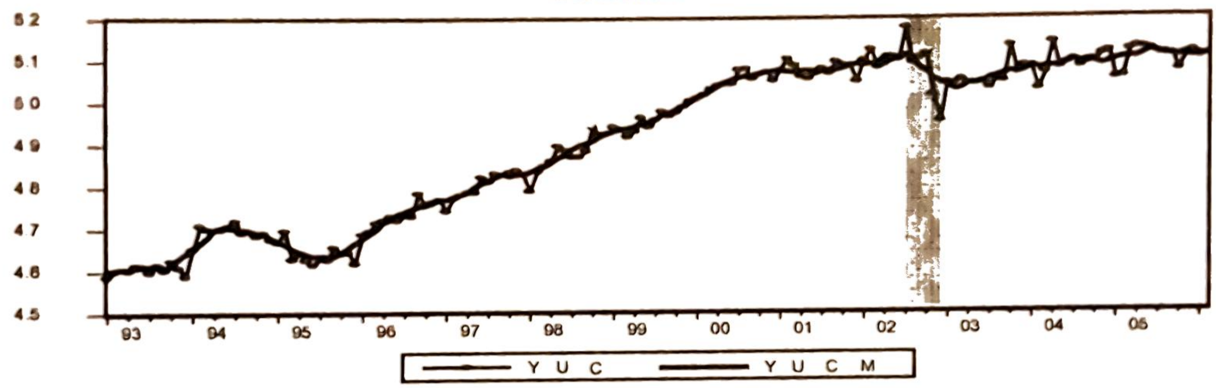
GRAPH 15
Tlaxcala



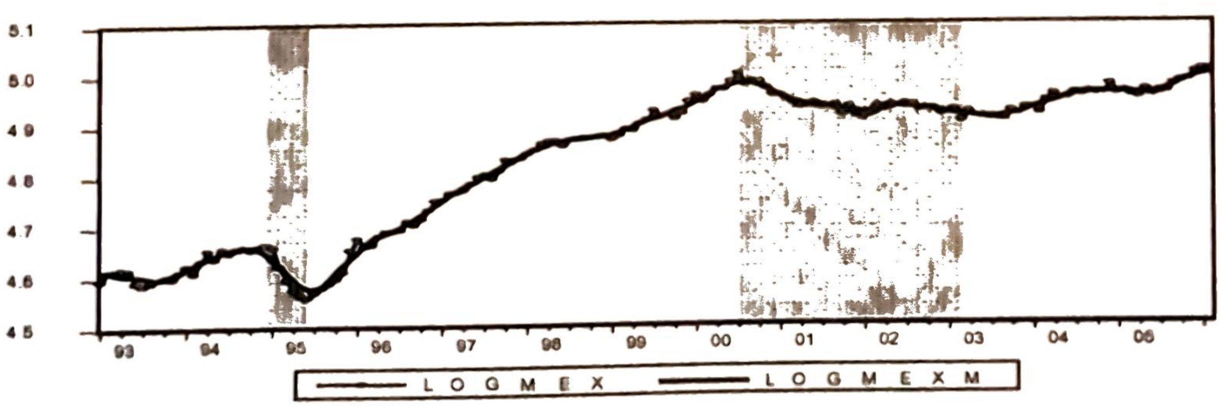
GRAPH 16
Veracruz



GRAPH 17
Yucatan



GRAPH 18
National



According to the AKO methodology, we replaced the extreme values when found.[16] Given the high volatility of the output series, the smoothing transformation in step two has been very important for the deletion of several potential turning points in the unsmoothed series. When comparing the smoothed with the unsmoothed series, it can be observed its utility for the elimination of short run fluctuations, especially in the cases of San Luis Potosi, Sinaloa, Veracruz and Tlaxcala.

In steps three and four, turning points are identified and the results are presented in table 3. The requirement that the amplitude of the phase has to be at least equal to a one standard deviation of the difference (in logs) was applied. The resulting set of turning points was compared with that corresponding to the smoothed series. Turning points in the original series that do not correspond to turning points in the smoothed series were not considered further. The resulting regimes are represented in the graphs, where shaded areas correspond to recession, while blank areas indicate expansions. The characteristics of the business cycle regimes are presented in table 4.

From the results presented in table 3 some general features can be highlighted. First, Coahuila has not experienced any business cycle at all; it has permanently grown during the sample period. Whilst, Yucatan and San Luis Potosi are the states that have experienced more cycles: 3 complete cycles. Second, it can be accepted that 4 states were in expansion at the beginning of the sample period, given that the amplitude of a phase criterion is fulfilled when the first value is compared to the value of the following peak.[17] Another 5 states present a trough at some time during 1993. Third, 6 states experienced a peak before the so-called "error of December", which implies that these states were actually in recession when the 1994-95 crisis exploded in the country. Fourth, only 8 states shared the 1995 trough. Fifth, it is important to state that

[16] See the Appendix for these dates.

[17] Strictly speaking, AKO argue that it is difficult to know whether the economy is at a particular regime at the beginning and the end of the sample period. Yet, we consider that the amplitude of the phase provides sufficient information to determine whether the economy is growing or declining.

TABLE 3

Classical Business Cycles Chronologies, 1993:01-2006-02

	Trough	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough	Peak
AGS	1993:01					2000:06	2001:12			
BC	1993:01					2000:10	2003:04	2004:12		
COAH										
DF		1994:09	1995:06			2000:09	2001:12	2002:04	2005:05	
DGO	1993:01			1998:09			2001:05	2004:10		
JAL		1994:07	1995:06			2000:09	2002:11			2005 10
MEX		1993:04	1995:09			2000:06	2003:04			
MOR		1993:08	1995:07			2000:08			2005:10	
NL		1994:08	1995:09							2006 02
PUE			1995:05					2003:07	2004.12	2005:09
QRO	1993:01					2000:08	2002:01		2003:01	2006:01
SLP	1993:11	1994:11	1995:07			2000:07	2002:11	2004:12		
SIN	1993:11			1997:06	1997:12	2001:06	2001:12			2006:02
SON	1993:05					2000:09	2003:11			2005 12
TLAX			1995:06			2001:06	2003:12	2004:09	2005:08	
VER	1993:07			1998:04	1998:10	2001:05	2003:05	2004:12	2005:12	
YUC	1993:12					2002:07	2002:12			2005 12
NAL		1994:12	1995:06			2000:07	2003:03			2006:02

TABLE 4

Classical Business Cycles Characteristics, 1993:01-2006-02

States	Expansions				Recessions				Cycles duration
	Total change	Average monthly change	Standard deviation	Duration	Total change	Average monthly change	Standard deviation	Duration	
AGS	11.86	0.70	3.15	70	-3.75	-0.58	4.40	18	88
BC	10.42	0.83	2.89	57	-5.36	-0.78	3.20	30	87
COAH	17.76	0.52	2.36	158	0.00	0.00	0.00	0	158
DF	5.07	0.89	2.27	34	-2.99	-0.71	2.03	21	54
DGO	7.10	0.52	2.48	55	-2.82	-0.40	2.14	32	87
JAL	5.16	0.28	1.66	49	-2.88	-0.42	2.08	19	68
MEX	10.04	0.74	1.72	57	-2.59	-0.35	1.95	32	89
MOR	11.09	0.74	2.74	61	-5.00	-0.65	3.60	43	104
NL	12 70	0.46	1.37	125	-2.03	-0.62	1.08	14	139
PUE	12.49	1.79	6.27	54	-6.07	-1.39	8.75	17	71
QRO	10.78	0.64	2.53	70	-3.02	-0.69	3.30	17	87
SLP	5.89	0.89	2.24	33	-3.33	-1.07	2.80	18	51
SIN	5.01	0.36	2.46	45	-3.25	-0.14	1.53	6	51
SON	9.36	0.99	3.45	33	-7.48	-0.74	2.86	38	71
TLAX	8.05	1.59	2.63	41	-3.08	-0.62	2.75	21	62
VER	3.50	0.42	1.98	35	-2.16	-0.58	2.25	14	49
YUC	10.01	0.41	3.06	70	-0.63	-2.42	6.77	5	75
NAL	5.89	0.46	1.04	48	-2.12	-0.85	1.24	20	68

the trough and the peak that seems to be common for most states are those dated over the periods 2000-2001 and 2001-2003, respectively. Sixth, although it is difficult to find a common cycle after that, it is possible to identify some common regimes between some states, namely, Baja California, Durango and San Luis Potosi, Jalisco and Yucatan, and Tlaxcala and Veracruz. Finally, it calls to our attention the long and sustained expansion of Nuevo Leon after the trough of 1995.

On the basis of these business cycle chronologies, the characteristics of the business cycle regimes are presented in table 4. This information allows us to evaluate the claims of Mitchell (1927) and Keynes (1936) regarding regime-dependent characteristics of the business cycle. In particular, it can be observed that the types of asymmetries documented in the literature for other countries and sectors[18] are present only in some cases. It is apparent the existence of asymmetries in duration: in all cases, including the national one, expansions last longer than recessions. Excluding Coahuila, which has permanently being growing, Nuevo Leon exhibits the longest expansion in the average (125 months). On the contrary, Morelos and Sonora have experienced the longest recessions (43 and 38 months in the average, respectively).[19]

To analyse the existence of asymmetries in magnitude, we compare two measures across regimes: the average total percentage change from one turning point to the following and the average monthly growth rate. For the former there is no evidence of asymmetry of the kind reported in the literature; on the contrary, increases in state production during expansions seem to be greater than decreases in recessions. For the latter measure, falls during recessions seem to be greater than increases during expansions only in 6 states and in the national production. Thus, in general, there is no clear evidence of conventional asymmetries over the business cycle regimes regarding mean, which is consistent with the information reported according to the lines of DeLong and Summers (1986).

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[18] See AKO, Mejía, *et al.* (2005) and Mejía (2004).

[19] Notice, however, that these figures correspond only to one regime in the cases of Nuevo Leon and Sonora.

In turn, there is evidence of asymmetric volatility, with recessions being more unstable, in 12 cases, including the national one. In other words, the growth rates during recessions of these economies experienced more heterogeneity. Like in the basic statistics, Puebla shows a large volatility also during the cycle regimes.

In summary, on the basis of a classical business cycles approach we can conclude that economic dynamics over the business cycle exhibits significant asymmetry only in duration. There is some evidence of asymmetries in volatility in most cases. Yet, the evidence of asymmetry in mean is less conclusive.

4.2. BUSINESS CYCLES REGIMES SYNCHRONISATION

In this section we report the results of the application of Pearson corrected contingency coefficient, defined in expressions (1) and (2), to measure the synchronisation of the business cycle regimes of the states of Mexico. To characterise the associations among those regimes, we define arbitrary ranges for the correlation coefficients. We consider that there exists a "strong" association when the coefficient is greater than 60% and that there exists a "mild" association when the coefficient lies between 40 and 60%. Otherwise we say that there is a "low" association between business cycle regimes.

By applying the aforementioned ranges, we find *very strong* associations between the business cycle regimes of different pairs of countries: Baja California and Sonora, the State of Mexico and Morelos, the Distrito Federal and Morelos and the Distrito Federal and the State of Mexico, Aguascalientes and Queretaro, and Jalisco and San Luis Potosi. It is important to highlight the very strong association of the national cycle with those of the State of Mexico, Jalisco and San Luis Potosi. In all these cases, the correlation coefficient is above 90%. Furthermore, observe that nine states have a *strong* association to the national business cycle (see Table 5).

On the other hand, notice that this evidence may reflect the existence of regional business cycles. In particular, as mentioned above, the business cycle regimes of the two Northern states considered in this study, Baja California

TABLE 5

Correlation and Pearson´s Corrected Contingency Coefficients for the complete Sample: 1993:01-2006:02

ESTADOS	AGS	BC	DF	DGO	JAL	MEX	MOR	NL	PUE	QRO	SLP	SIN	SON	TLAX	VER	YUC
AGS																
BC	**63.4**															
DF	41.5	58.2														
DGO	49.3	1.4	29.4													
JAL	58.9	**76.9**	**63.1**	10.2												
MEX	50.4	**67.4**	***90.7***	30.7	**84.3**											
MOR	30.2	**60.6**	***96.1***	40.5	**69.2**	***96.5***										
NL	17.5	27.7	26.1	29.4	53.0	55.6	29.2									
PUE	22.0	33.6	57.3	33.4	28.3	-	51.1	11.4								
QRO	***92.7***	**73.4**	47.1	36.7	**68.9**	50.4	41.2	17.7	22.0							
SLP	**70.8**	**79.9**	**60.0**	7.1	***92.1***	**79.5**	**65.3**	30.7	34.3	**75.3**						
SIN	38.3	28.8	1.0	24.9	21.4	0.0	6.6	14.5	18.1	47.7	22.8					
SON	**60.2**	***91.9***	**65.8**	4.4	**69.3**	**69.2**	**63.0**	28.9	8.4	**69.7**	**71.8**	22.8				
TLAX	4.7	**71.5**	**73.5**	51.0	43.5	**78.9**	**81.2**	18.2	16.4	9.4	48.8	16.3	**73.6**			
VER	8.4	**81.2**	37.6	34.7	34.6	42.5	44.2	30.7	36.5	21.4	52.7	19.8	58.7	**79.9**		
YUC	9.7	48.6	28.5	15.9	31.4	30.0	22.9	9.3	11.4	9.7	32.4	8.0	42.7	39.5	40.1	
NAC	**67.8**	**87.8**	**66.3**	2.8	***95.5***	***94.8***	**70.4**	35.1	33.3	**72.3**	***94.9***	20.4	**80.3**	51.3	46.3	41.5

and Sonora, are strongly associated (with a correlation coefficient of 91.9%). Also, there are important links between the business cycles of the states placed in the Centre-North area, namely Aguascalientes, Queretaro and San Luis Potosi (with correlation coefficients lying between 70.8 and 92.7%). In the case of the central states there are important associations between the business cycles of the State of Mexico, the Distrito Federal, Morelos and Tlaxcala (with coefficients between 71.5 and 96.1%). Given that these states are geographically closed to each other, it is natural to think that the reported correlations are explained by economic interactions.

In turn, there is some evidence of inter-regional relationships. For example, Jalisco and other states of the Centre-Northern and Central areas seem to have related cycle regimes, whilst Baja California and the Distrito Federal's cycles have an apparent association with states of the same regions. These results may be explained by similarities in the historical industrialisation policies. Specifically, the Pearson correlation coefficients suggest the existence of common business cycle regimes for states that started their industrialisation during the import-substitution industrialisation process, such as the Distrito Federal, the State of Mexico and Jalisco. Whilst, the apparent common cycles of the recently industrialised states of Aguascalientes, Baja California, Sonora, San Luis Potosi and Queretaro may be explained by the importance of the "maquila" activities in their structure production.

Against this tendency to regional and inter-regional integration, some states have largely idiosyncratic business cycles. Sinaloa, Durango, Nuevo Leon, Puebla and Yucatan exhibit business cycle regimes that are moderately associated, at most, to the cycle regimes of other states. What we find odd is that the business cycles of Puebla and Nuevo Leon are not synchronized to those of their neighbours, especially because they started the industrialisation and have the biggest economies in their respective regions.

In summary, we can conclude that there exists evidence of important links between the business cycle regimes of the states of the different regions of Mexico. Even more, there seems to be important inter-regional interactions. Yet, it is difficult to claim that a national cycle exists and additional evidence is needed on this issue.

5. CONCLUSIONS

We have applied a classical business cycles methodology to date turning points and analyse asymmetries over the business cycle for seventeen states of Mexico. An essential feature of this methodology is that distinguishes between short-run declines and recessions and between short-run upturns and expansions.

The results suggest the existence of significant asymmetric behaviour over the business cycle only for some states in the sample. In agreement with the considerations of Mitchell (1927), Keynes (1936), and Burns and Mitchell (1946), it is found that economies switch from expansions to recessions and that the latter are less persistence than the former. In addition, the results suggest that recessions are more volatile than expansion in most cases. Yet, the evidence does not indicate that, in general, recessions are deeper than expansions, which differs from other results available on the literature.

These results may differ from others previously reported in the literature for some Latin American countries and some productive sectors of Mexico due to the fact that our sample period excludes the 1980´s when these economies experienced very deep recessions. At least, this fact may explain the absence of asymmetries in mean and the weakening of the evidence on asymmetries in volatility. One implication of this conjecture is that the Mexican economy and its states have experienced transformations that may be deriving in less dramatic and harmful recession episodes. It may be the case that reforms implemented from the 1980's in Mexico have transformed the functioning of the economy. Also the last recession of the mexican economy seems to have had causes different to those of previous crises. The fact that the last recession may have had recessions of the US as the unique cause could have yield a less dramatic recession.

Regarding business cycle regimes synchronisation, our results suggest that there exists important links between the business cycle regimes of the states of the different regions of Mexico. Even more, there seems to be important inter-regional interactions between the states of the Northern and Central areas of the country. However, it is difficult to claim that a national cycle exists.

We consider that this paper contributes to the understanding of the business cycles in Mexico by using disaggregated data. In our view the analysis of this kind of data is still rare in the literature.

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APPENDIX

States	Outliers				
AGS	2002/12				
BC	1993/12	2002/05	2006/02		
COAH	1996/01	2004/03			
DF	1995/01	1995/12	2002/08		
DGO	1998/01				
JAL	1993/09	2004/03			
MEX	1995/10	2000/01	2001/01		
MOR	1995/01	2000/01	2001/01	2004/01	
NL	1995/05	2002/08			
PUE	1994/02	2004/11			
QRO	2001/12	2003/01	2004/01		
SLP					
SIN	1998/01				
SON	2000/02	2004/04			
TLAX	2002/04	2002/06	2004/01	2005/03	2006/01
VER	1997/11	1999/12	2001/10	2002/05	2003/06
YUC	2002/09				
NAL	1993/12				