# CLASSICAL BUSINESS CYCLES IN LATIN AMERICA: TURNING POINTS, ASYMMETRIES AND INTERNATIONAL SYNCHRONISATION

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*Resumen:* Se emplea la metodología de los ciclos económicos clásicos para analizar los regímenes (expansión/recesión) de los ciclos económicos de varios países latinoamericanos. Se encuentra que las recesiones son más pronunciadas, menos persistentes y más volátiles que las expansiones. Sin embargo, la dinámica de las transacciones económicas intra-regionales sugiere que tales asociaciones podrían ser explicadas por la instrumentación de políticas similares o por el enfrentamiento de choques comunes.

*Abstract:* A classical business cycles approach is applied to study turning points, asymmetries and international synchronisation of business cycle regimes (expansion/recession) for several Latin American countries. The results suggest that recessions are characterised by deeper change, less persistence, and greater volatility than expansions. However, existing evidence about intra-regional economic transactions suggests that these associations might be explained by similar economic policies and common external shocks.

## 1. Introduction

After the general recession of 1973-1974 experienced by most developed countries, the study of cyclical fluctuations has become an impor-

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tant activity both theoretically and empirically. One branch of the literature has paid particular attention to the analysis of the asymmetric behaviour of economies over the business cycle (see for example Neftci, 1984; DeLong and Summers, 1986; Hamilton, 1989, and Sichel, 1989). This branch posits the existence of asymmetry in the behaviour of the main macroeconomic time series and in their relationships over the cycle. This implies that the economy functions in different ways when it is in recession or in expansion. In particular, their work suggests that recessions are deeper, more volatile, less persistent, and shorter than expansions.

Although this issue is not actually a new one -these features had been observed since the first third of this century by Mitchell (1927) and Keynes (1936) studies on business cycles are scarce outside the United States, US (Artis, Kontolemis, and Osborn, 1997). This situation is especially true for Latin America. Existing papers have found evidence that the effects of shocks tend to persist for a substantial length of time (Cuddington and Urzúa, 1988; Ruprah, 1991; Mejía and Hernández, 1998). Other authors have found that supply shocks tend to dominate output fluctuations even in the short-run (Hoffmaister and Roldós, 1996, 1997). Analogous conclusions are stated by Kydland and Zarazaga (1997), who suggest that nominal factors are unable to account for any significant fraction of the business cycle of Latin America. Recently, Mora (1997) has presented evidence of nonlinearity and asymmetries in the Colombian business cycle.

In an international perspective, it is widely recognised that movements in macroeconomic aggregates are related across countries, and recent research has found evidence of positive correlation of output across developed countries (see for example Backus and Kehoe, 1992; Backus, Kehoe, and Kydland, 1992; Canova and Delias, 1993; Engel and Kozicki, 1993; Christodoulakis, Dimelis and Kollintzas, 1995; Artis and Zhang, 1997). Recently, Artis, Kontolemis, and Osborn (1997) and Krolzig (1997) have analysed the business cycles of developed countries, considering explicitly the properties of expansions and recessions. They have found substantial synchronisation and co-movements in output. Krolzing points out that these common cycles are largely due to common international shocks, especially since the oil-price shock in 1973. The conclusions of other studies are qualitatively similar. So we can say that there is strong evidence for the existence of common cycles in developed countries.

Two mechanisms have been mentioned in the literature to explain this procyclicality. First, significant international economic interdependence, which is correlated with the relative size of the economy and on the degree of openness; since transactions in goods and services and assets can act as the transmission channel for fluctuations across countries. The second transition mechanism includes common "exogenous" external or internal disturbances, similar economic policies, similar technological shocks, etcetera (Canova and Delias, 1993).

On the other hand, interest in the analysis of international fluctuations has recently revived because countries in different regions over the world are preparing to enter into various sorts of economic co-operation and/or integration agreements and a minimal degree of homogeneity among countries has been mentioned as a requirement (Christodoulakis, Dimelis and Kollintzas, 1995; and Arnaudo and Jacobo, 1997).

In the Latin American case, there are few studies that address international business cycles and the results are not conclusive. For example, Engel and Issler (1993) analyse common features of Argentina, Brazil, and Mexico and find that the data show both short and long-run co-movements only between the first two countries. By using decomposition methods, Arnaudo and Jacobo (1997) find that Mercosur[1] countries' economic fluctuations are highly variable and not uniform over time; they find significant correlations only between Argentina and Brazil. Finally, Iguíñiz and Aguilar (1998) find that economic fluctuations of Andean countries[2] and of the United States, US, are positively correlated from 1950 to 1980, but that most correlations become non-significant over the 1981-1995 period.

As can be observed, some research has been conducted made in this area. However, few studies address issues of nonlinearities and regime characteristics.[3] In this context, the aim of this paper is contribute

[1] Mercosur (Argentina, Brazil, Paraguay, and Uruguay) was signed in 1991, but its direct antecedent is an integration act signed between Argentina and Brazil in 1986 (see Edwards, 1995, Chapter 5).

[2] The Andean Trade Preference Act (Bolivia, Colombia, Ecuador, Peru, and Venezuela) was renewed in 1990, more than two decades after its first launching (see Edwards, 1995, Chapter 5).

[3] Some studies, including Hausmann and Gavin (1996), try to distinguish between expansions and recessions; by delining a recession as a year in which real GDP declines. As we will see later, one can confuse short-run fluctuations with recessions by using this approach.

to the characterisation and understanding of Latin American business cycle. In particular, we date turning points, analyse asymmetries between expansions and recessions —in terms of magnitude, duration, and volatility—, and measure international synchronisation of business cycle regimes. To do so, we apply the methodology developed by Artis, Kontolemis and Osborn (1997) to the level of real GDP per-capita for eight Latin American countries to identify and characterise classical business cycles. Finally, we analyse international synchronisation of regimes.

This paper is organised as follows. In section 1 we describe the data set and explain the general characteristics of the series. In section 2 we describe the methodology used to analyse classical business cycles and apply it to the levels of the series. In section 3 we analyse international synchronisation. Finally, we make some general remarks.

## 2. Basic Statistical Features of Real GDP Per-Capita

### 2.1. *General Statistics*

We consider the experience of eight countries: Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. We have chosen these countries because they are the largest Latin American economies and because most of them have in common a long period of sustained growth that was interrupted by the international debt crisis in the early 80s. After that, most of them have implemented stabilisation and structural change policies. We analyse the dynamics of the US economy as well in order to compare the consistency of our methodologies and in order to analyse the links between its economy and the Latin American ones. The analysis is performed for annual real GDP per-capita over the period 1950-1995 and the data set is an updated version of that of Summers and Heston (1991). The methodology used to update the information is detailed in appendix 1. Table 1 summarises the data using descriptive statistics and augmented Dickey-Fuller, ADF, unit root tests.

The descriptive statistics show great heterogeneity in the behaviour of real GDP per-capita across countries. Using the case of the United States as a reference, Brazil, Chile, Colombia, and Mexico had an average growth rate greater than that of the United States. On the other hand, Argentina, Bolivia, and Venezuela experienced an average growth rate of around a half or a third of the growth of the other countries. The variances of the growth rates show the high degree of volatility of Latin

**Table 1**

*Latin America: Gross Domestic Product Per-Capita, 1950-1995*
*(Basic Statistics and ADF Unit Root Tests)*

| | *Argentina* | *Bolivia* | *Brazil* | *Chile* | *Colombia* | *Mexico* | *Peru* | *Venezuela* | *United States* |
|---|---|---|---|---|---|---|---|---|---|
| *1. Basic statistics: Growth rates* | | | | | | | | | |
| Mean | 0.74 | 0.68 | 2.77 | 1.97 | 2.18 | 2.02 | 1.39 | 0.56 | 1.80 |
| Variance | 28.11 | 20.13 | 16.68 | 34.53 | 7.25 | 19.61 | 39.07 | 22.94 | 6.00 |
| Skewness | -0.49 | -1.23 | -0.34 | -1.66 | -0.22 | -1.53 | -1.05 | -0.56 | -0.48 |
| Excess Kurtosis | -1.02 | 3.43 | -0.26 | 3.31 | -0.73 | 2.30 | 1.80 | 0.16 | -0.49 |
| Median | 2.20 | 1.19 | 3.22 | 2.84 | 2.40 | 3.21 | 1.78 | 0.94 | 2.01 |
| Minimum | -10.08 | -16.76 | -7.36 | -17.81 | -3.50 | -12.94 | -19.25 | -13.51 | -3.72 |
| Maximum | 9.00 | 8.37 | 10.47 | 9.42 | 7.36 | 7.69 | 12.21 | 8.64 | 6.06 |
| *2. ADF unit root tests* | | | | | | | | | |
| Level: with constant and trend | | | | | | | | | |
| *t*-statistie | -1.37 | -2.17 | -1.10 | -1.87 | -2.24 | -0.02 | -2.07 | -2.17 | -2.28 |
| Growth rates: with constant | | | | | | | | | |
| *t*-statistic | -6.06* | -2.59 | -4.52* | -5.05* | -4.25* | -3.94* | -4.69* | -5.20* | -6.57* |

The unit root tests on levels were undertaken including a constant and a trend; tests on growth rates were carried out including only a constant. The critical values are those of Fuller (1976) and in the first case are the following for 10, 5 and 1% of signifieance: -3.18, -3.50 and -4.15, respectively; in the second case they are -2.60, -2.93, and -3.58, respectively. ***, ** and * means significant at 10, 5 and 1%, respectively. In both kind of tests a specific number of lags was included to represent the autocorrelation of the residuals; such a number was determined according to the value that minimised the Schwarz criterion and the behaviour of the autocorrelation of the residuals did not show any autocorrelation. Specifically, the number of lags used in the tests in levels and in growth rates was as follows: Argentina, 2 and 1; Bolivia, 3 and 2; Brazil, 1 and 0; Chile, 1 and 0; Colombia, 3 and 3; Mexico, 0 and 0; Peru, 1 and 1; Venezuela, 1 and 0; and the United States, 0 and 0, respectively.

American economic growth. This can be seen in the relative sizes of the variances: except for Colombia, whose rate of variance was similar to that of the US. The rate of variance of the other countries was at least three times the variance of the United States; Chile, Peru and Argentina showed the worst performance in this aspect. Similar conclusions can be drawn from the range of variation of the growth rates: except Colombia once again for the difference between the minimum and the maximum values of growth rates varies between 18 percentage points for Brazil and 31 percentage points for Peru.

As mentioned above, asymmetric behaviour has been detected for countries such as the United States and the United Kingdom since the first third of this century. For example, Mitchell (1927) 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". In the same sense, 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".

As DeLong and Summers (1986) have pointed out, this implies that there should be significant skewness in a frequency distribution of 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.[4] These statistical properties of asymmetry can be evaluated with the information presented in table 1.

As regards the first implication, we observe that the largest yearly downturns are more severe than the largest yearly upturns, which can be inferred from the fact that, except in three cases, the minimum growth rate value is greater than the maximum growth rate value in absolute

[4] 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 Salvatore, 1982).

terms. Second, in accordance with the claims of DeLong and Summers, the skewness is negative and the median is greater than the mean for all economies. Third, there is excess of kurtosis in five cases, especially in Chile and Bolivia, which may reflect the importance of the minimum growth rates (which are twice the absolute value of the maximum growth rates). This information allows us to draw preliminary conclusions as to the existence of asymmetries in the cyclical fluctuations of Latin American countries. More formal methods will be used below.

From the previous information and from the information presented in graphs 2 to 9 in section 2, where the levels of real GDP per-capita are shown, four important points can be made. First, the level of the variables has in general an apparent positive trend, although this is not constant. Second, most of the countries analysed had periods of sustained growth until the 70s or early 80s, followed by periods of zero or negative growth. This is clearly shown by the dramatic change in the slope of the levels of the variables —except in the cases of Chile (which had two huge falls —one in the early 70s and the other in the early 80s- followed by periods of dramatic growth) and Colombia (where a slight decline was followed by sustained growth).[5]

Third, the behaviours of real GDP per-capita has shown great volatility. This volatility can be observed in both the amplitude of the variations of the growth rates, which are especially large in the periods when the trends of the levels of the variables change, and in the huge negative values of the growth rates in specific periods.[6]

Fourth, the values of skewness and kurtosis and the relationship between medians and means suggest the importance of asymmetries in the dynamics of cyclical fluctuations in Latin American countries.

On the other hand, until the early 80s it was accepted that economic growth could be characterised as the sum of two components: a deter-

[5] Some authors (Elías, 1992; Solimano, 1996) have suggested that growth from the 1940s to the 1960s was mainly based on the accumulation of production factors (capital and labour), and that protectionist economic policies generated distortions in the economic incentives, which provoked a decreasing contribution of the increase in the total factors productivity in the long-run. It has been suggested that the growth between the late 1960s and the early 1980s resulted from an increasing level of government intervention financed by external indebtness.

[6] It has been argued that once the crisis started in 1981-1982, business cycles in Latin America might be characterised on the basis of "go" and "stop" policies, which have been closely related to the stabilisation policies and to responses to exogenous shocks (see Hamann and Paredes, 1991, for the Peruvian case).

ministic trend which reflects the stable long-run growth and a cyclical component that fluctuates around that trend; the stochastic component of economic growth would be associated with the latter.[7] The evidence presented by Nelson and Plosser (1982) changed this belief. They show that most US economic series are characterised by a process with a unit root, or are integrated of order 1, I(1). This implies that they are nonstationary series rather than stationary or I(0) (possibly around a deterministic trend). It is now accepted that series can have stochastic trends driven by current shocks, either real or monetary.

We apply Dickey-Fuller 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. The relevant *t*-statistic has to be contrasted with the critical value, corresponding to each model, presented in Fuller (1976).

The results for the logarithm and the first difference of real GDP per-capita of the countries analysed are shown in table 1.[8] The null hypothesis of a unit root can not be rejected in any case.[9] Consequently, it can be concluded that 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 that the effects of current fluctuations on the long-run behaviour of the economy are permanent.

Because the null hypothesis of a unit root in the levels of the series can not be rejected we then test whether the first difference is I(1). The results are shown in table 1 as well. The previous considerations about

[7] This view had been not only the opinion with respect to statistical issues, but a traditional vision in macroeconomics, where the determinants of the long-run economic growth and the behaviour of cyclical fluctuations were studied in separated models.

[8] As usual, autocorrelation was eliminated by augmenting with lags of the differenced variable; the number of lags was determined according to the autocorrelation function (correlogram) of the residuals and the Schwarz criterion.

[9] Similar results are found by Ruprah (1991) for Mexico and Mora (1997) for Colombia.

the critical values and number of lags used are valid in this case. The results suggest that —except possibly in the case of Bolivia, whose results are almost significant at 10%— the growth rate of the real GDP per-capita is stationary, or equivalently that the level of the variables is difference stationary or I(1). This result implies that the first difference of logarithm of the variables fluctuates around a constant mean, which may be zero.

## 3. Classical Business Cycles

The aim of this section is to date the turning points of the business cycle of eight Latin American countries and to analyse the properties of recessions and expansions. We use a classical business cycles approach in the spirit of Burns and Mitchell (1946).

### 3.1. *Concepts and Methodology*

We apply an annual version of the methodology used by Artis, Kontolemis and Osborn (1997, hereafter AKO). The AKO methodology is a simplified version of that of Bry and Boschan (1971). The latter is a computational procedure that accurately emulates the decision process of the National Bureau of Economic Research, NBER, committee in a univariate application. The main advantage of the AKO methodology is that it generates turning points very close to those of the NBER and it is based only on a univariate analysis whereas the NBER's dating process is based on the analysis of different series and uses different methodologies for each series.[10]

AKO use a classical business cycle approach in which periods of expansion and contraction are represented by a level of activity (instead of a growth cycles approach in which periods of expansion and contraction are represented as cyclical movements around a trend). We chose this approach for three reasons. First, starting with the paper by Nelson and Plosser (1982), increasing evidence has been presented supporting the existence of stochastic trends, which implies that the trend rever-

[10] 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 of this organisation for dating turning points, and AKO for an analysis of the methodology of Bry and Boschan (1971).

sion property no longer holds. Second, it has been shown that different detrending methods may yield different growth cycle chronologies (Canova, 1998), and that commonly used detrending methods may induce spurious cycles (King and Rebelo, 1993, and Osborn, 1995). Third, growth cycles are more symmetric in duration and amplitude than business cycles.

At least four considerations can be derived from the Burns and Mitchell's (1946, p. 3) definition of business cycle. First, even if there are some considerations about the need to study non-aggregated series, any analysis of the business cycle should be concerned with aggregate economic activity. Second, the different phases of the cycle are successive and alternate. Third, this implies that economic variables experience shifts between the different states of the cycle. Fourth, it is important to distinguish business cycles from shorter fluctuations.

Thus, the stages of the cycle are inferred primary from the level of economic activity. Following Boldin (1994) and many others, we can say that turning points are called *peaks* -the period immediately preceding a decline in real activity, or *recessions* -and *troughs* -the period immediately preceding an upturn, or *expansion.* 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.

The methodology used in this paper, and detailed in appendix 2, can be summarised in the following steps. In step 1 extreme values are identified and replaced because we are interested in looking for broad upward and downward movements and do not want these values to influence the procedure. An extreme value is defined as one whose (log) change compared with both adjacent years 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.

In step 2 original values are smoothed by using a centred moving average of three periods to reduce the importance of short-run erratic fluctuations. Turning points are tentatively identified in this smoothed series by the identification of points higher (peaks) or lower (troughs) than 1 year on either side, with peaks and troughs required to alternate.

In step 3 we return to the unsmoothed data 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 1 standard error of the annual log changes and that the duration of a cycle be at least 3 years.

The final stage, step 4, compares the two sets of tentative turning points. When there is a close correspondence between the two sets of tentative turning points (and only in this case), the existence of a turning point is confirmed and dated as identified in the unsmoothed (original) series.

### 3.2. *Dating Turning Points and Regimes*

The methodology described above was applied to date the turning points of Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. In the analysis, the annual real GDP per-capita over the period 1950-1995 was used. To evaluate the accuracy of our methodology, it was also applied to the real GDP of the US and the resulting turning points were compared with those identified by AKO using monthly data.

In step 1, the only outlier identified and replaced Bolivia was the GDP of in 1953. The importance of smoothing in step 2 is illustrated by the deletion of two potential turning points in the unsmoothed series of real GDP per-capita of the US because no corresponding turning points are detected in the smoothed series.[11] In steps 3 and 4, turning points are identified and the results are presented in graphs 1 to 9;[12] peaks and troughs are represented by $P^*$ and $T^*$. The chronologies and characteristics of these cycles are presented in tables 2 and 3.

Given the considerations indicated in footnote 12, the results shown in table 2 and graph 1 indicate that the turning points identified for the United States correspond almost exactly to those indicated by AKO: they differ only in that we fail to identify a peak and a trough in 1969 and 1970, respectively. In addition, because of the difference in the frequency of data, the dates of the turning points around 1980 do not coincide: AKO find a peak in March 1980, a trough in July 1980, a peak in July 1981, and a trough in December 1982, while we find only a peak in 1979 and a trough in 1982. Despite these differences, we consider that the methodology used in this paper is accurate for annual data and that the identification of turning points for Latin America can be based upon it.

[11] Graphs of the smoothed series are not presented.

[12] In the case of the United States for the recession which started in 1989 and finished in 1991, the corresponding ratio of the difference of the (log) series to the standard error of this first difference was of 0.984; because this value is very close to 1, those years were considered as turning points.

The dating of turning points for the Latin American countries can be seen in graphs 2 to 9 and table 2. From the results some general features can be highlighted. First, it can be observed that in general the countries examined experienced a long period of sustained growth which finished with a general peak in the late 70s or early 80s.

Second, with the exception of Colombia, the countries experienced a recession associated with the external debt crisis. Even though the recession started before 1981-1982 in some cases, most countries were in recession at least over the period 1982-1983.

Third, after peak just mentioned, the frequency of the cycles increases, which is reflected in a reduction in the period of the cycle, which in turn is a consequence of the decrease in the duration of the expansions (compare, for example, the duration of the expansions of Argentina and Venezuela in graphs 2 and 9, respectively, before and after 1980).

Fourth, even though all countries had a peak around 1980, there are important differences that allow us to provide the following classification: Brazil and Mexico had no recessions before that peak; Argentina, Bolivia, and Venezuela presented only one recession previous to the same peak; Chile and Peru showed recessions from the first half of the 70s; and Colombia is a country with only one recession (from 1955 to 1958). Comparing grosso modo these behaviours with that of the United States, it can be observed that the economies of these Latin American countries performed better than that of the United States in that the latter presented two recessions prior to 1979.

In table 3 the characteristics of completed cycles are presented.[13] In the penultimate row, we can observe the existence of asymmetry in the average growth rates, since in expansions these Latin American countries grow on average at a rate of 3.1% per year, while in recessions they decrease at a rate of 4.1%. There is also significant asymmetry in the volatility of growth: the variance during expansions is less than half the variance during recessions. An opposite asymmetry is found in the average duration of expansions and recessions: on average expansions last for 7 years, while recessions last on average for only 5 years.

[13] The use of completed cycles implies that expansions or recessions in progress at the beginning and end of the sample period are excluded. Thus, we have calculated variances for expansions and recessions even though the number of observations is small in some cases (see note in table 3). However, although we should be cautious, the conclusions that can be drawn from this information are very interesting and consistent with the evidence presented by other authors.

With respect to the average growth rates of specific countries, in five out of eight cases, the absolute value of growth during recessions is greater than that during expansions. In addition, in Brazil and Mexico the average growth rates during expansions was less than 1 percentage point greater than the absolute value of growth during recessions. Only in Bolivia was the average growth rate during expansions more than a percentage point greater than the absolute rate during recessions.

In five out of seven countries the variance during recessions is different and greater than the variance during expansions.[14] Chile, Mexico, and Peru are extreme examples, where the ratio of the variance in recessions to the variance in expansions is at least 2.5. On the other hand, the duration of recessions is shorter than expansions in three cases (Argentina, Chile, and Venezuela) and in another four the duration is the same (Bolivia, Brazil, Mexico, and Peru). This fact worsens the performance of these economies because in Peru the absolute value of the growth rates in recessions is greater than the absolute value of the growth rates in expansions and because in some cases recessions last for long periods (11 years in Bolivia, for example).

Finally, let us consider the duration of the cycles measured as the sum of the average duration of recessions plus expansions. The Latin American average is very similar to that of the United States, 12 and 11 years, respectively. However, there is a great variability in the average duration, which ranges from 6 years in Peru to 22 years in Bolivia. These results, however, must be treated with some care because in some cases long expansions prior to the 1981-1982 recession and short expansions and recessions posterior to the turning points in the early 1990s are excluded as incomplete since the beginning or end of the cycle is unknown.

In summary, on the basis of classical business cycles we can conclude that economic dynamics over the business cycle exhibits significant asymmetries in Latin American countries. This is an interesting result because most studies on business cycles in Latin America have not considered the properties of recessions and expansions. It is important to keep in mind that economies might function differently in recessions and expansions.

[14] Colombia is excluded from this comparisons because the variance could not be calculated due to the fact that there is only one observation for expansions.

**Table 2**

*Latin America: Classical Business Cycles Chronologies for Real GDP Per-Capita, 1950-1995*

| | *Argentina* | *Bolivia* | *Brazil* | *Chile* | *Colombia* | *Mexico* | *Peru* | *Venezuela* | *United States* |
|---|---|---|---|---|---|---|---|---|---|
| Trough | 1952 | | | | | | | | |
| Peak | | | | 1953 | 1955 | | | 1957 | 1955 |
| Trough | | 1959 | | 1956 | 1958 | | | 1960 | 1958 |
| Peak | 1961 | | | | | | | | |
| Trough | 1963 | | | | | | | | |
| Peak | | | | 1971 | | | 1975 | 1970 | 1973 |
| Trough | | | | 1976 | | | 1978 | 1973 | 1975 |
| Peak | 1980 | 1979 | 1980 | 1981 | | 1981 | 1981 | 1978 | 1979 |
| Trough | 1985 | | 1983 | 1983 | | | 1983 | 1985 | 1982 |
| Peak | | | | | | | | | |
| Trough | | | | | | 1987 | | | |
| Peak | 1987 | | 1987 | | | | 1987 | 1988 | 1989 |
| Trough | 1990 | 1990 | 1992 | | | | 1992 | 1989 | 1991 |
| Peak | | 1993 | | | | 1992 | | 1992 | |

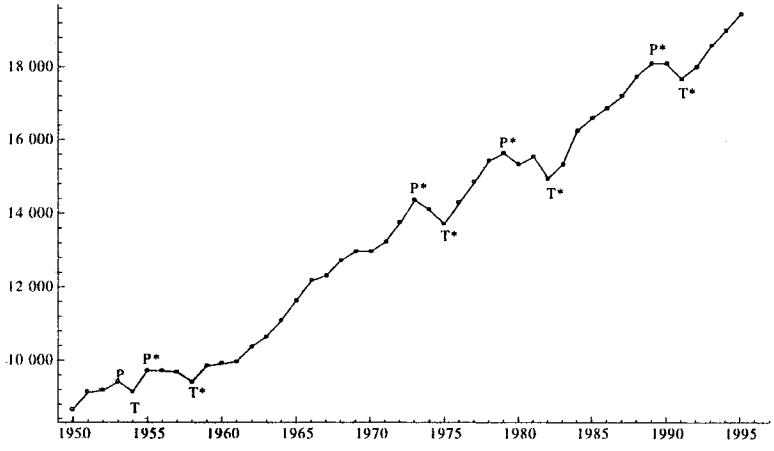
**Table 3**

*Latin America: Classical Business Cycles Characteristics, 1950-1995 (Completed Business Cycles)*

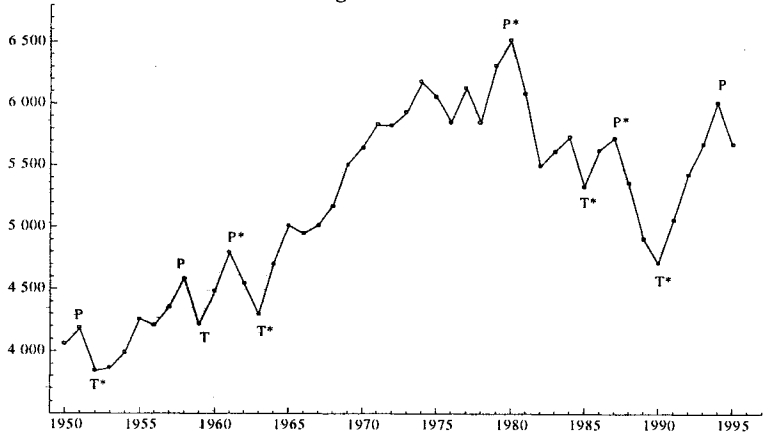
| | *Expansions* | | | *Recessions* | | | |
|---|---|---|---|---|---|---|---|
| | *Anual change* | | | *Annual change* | | | *Cycles* |
| | *(Average)* | *Variance* | *Duration* | *(Average)* | *Variance* | *Duration* | *Duration* |
| Argentina | 2.52 | 16.17 | 9 | -5.35 | 16.39 | 3 | 12 |
| Bolivia | 3.00 | 5.95 | 11 | -1.96 | 6.03 | 11 | 22 |
| Brazil | 3.88 | 6.11 | 4 | -3.02 | 8.90 | 4 | 8 |
| Chile | 3.90 | 9.95 | 10 | -6.05 | 45.10 | 3 | 13 |
| Colombia | 1.34 | | 1 | -2.43 | 1.25 | 3 | 4 |
| Mexico | 3.97 | 2.64 | 6 | -3.43 | 27.64 | 6 | 12 |
| Peru | 3.33 | 14.96 | 3 | -6.74 | 40.50 | 3 | 6 |
| Venezuela | 3.02 | 8.34 | 8 | -3.99 | 13.73 | 3 | 11 |
| LA Average | 3.12 | 9.16 | 7 | -4.12 | 19.94 | 5 | 12 |
| United States | 2.98 | 2.54 | 9 | -1.48 | 2.37 | 2 | 11 |

Annual average changes are expressed as percentages, while durations refer to years. These figures are computed over completed recessions or contractions. The number of years considered in the calculations of annual average changes and variances for expansions and recessions for each country are as follows: Argentina, 28 and 11; Bolivia, 23 and 12; Brazil, 5 and 6; Chile, 21 and 10; Colombia; 1 and 3; Mexico, 6 and 6; Peru, 6 and 10; Venezuela, 16 and 11; United States, 21 and 8, respectively. The averages for Latin America were obtained as the arithmetic average of the corresponding values of the listed countries.

**Graph 1**
*United States: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*



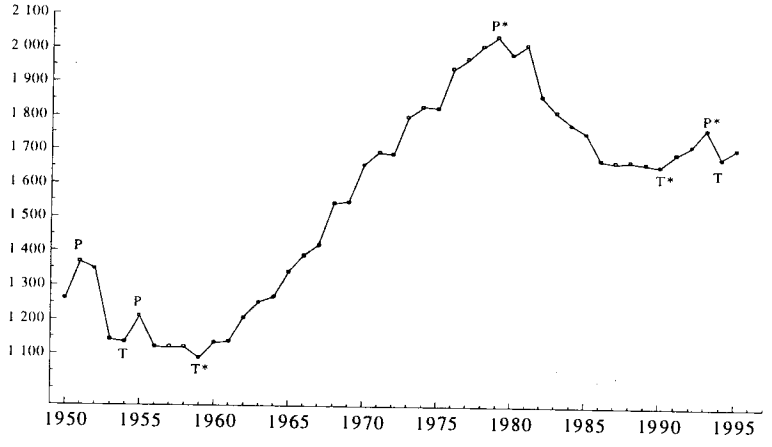

**Graph 2**
*Argentina: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*




* Indicates turning points.

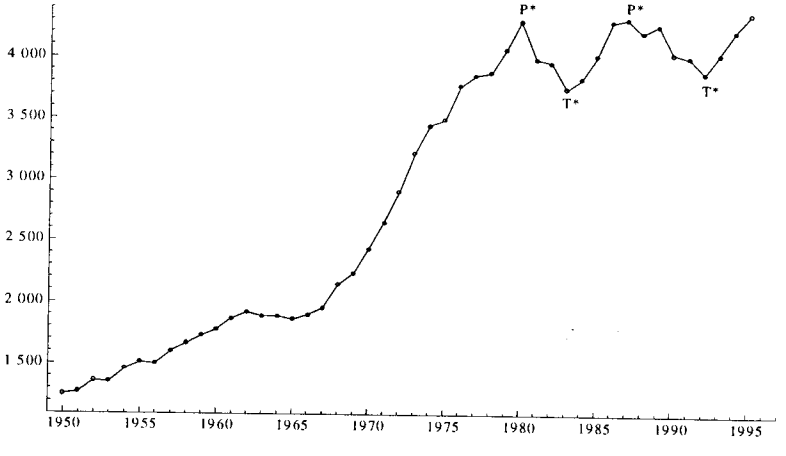
**Graph 3**

*Bolivia: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*



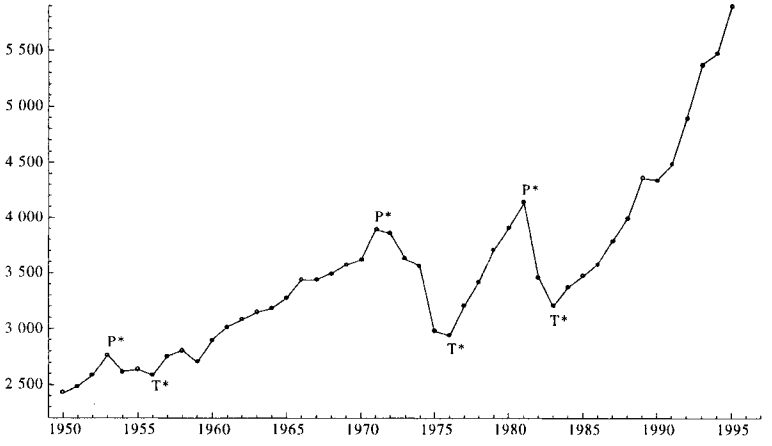

**Graph 4**

*Brazil: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*

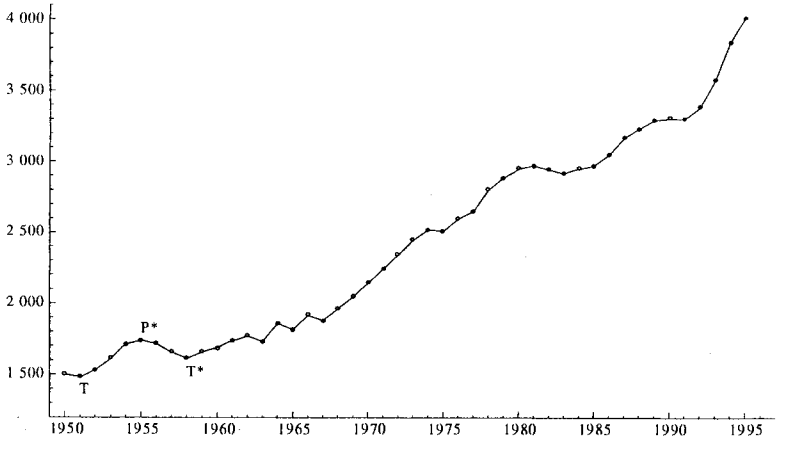



* Indicates turning points.

**Graph 5**
*Chile: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*




**Graph 6**
*Colombia: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*



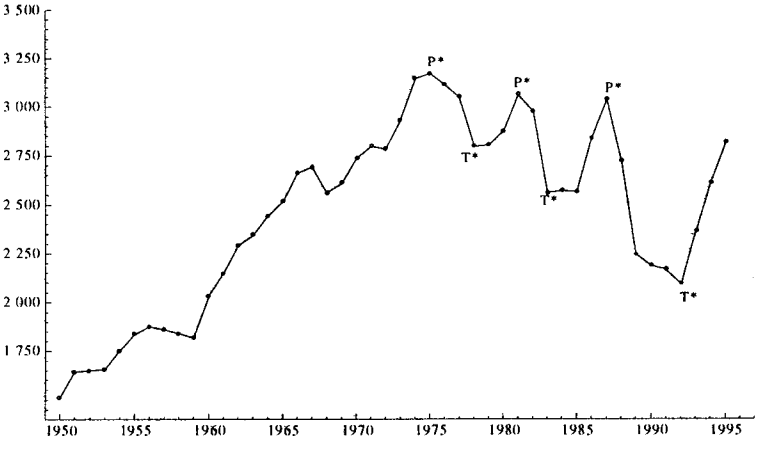

* Indicates turning points.

**Graph 7**

*Mexico: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*

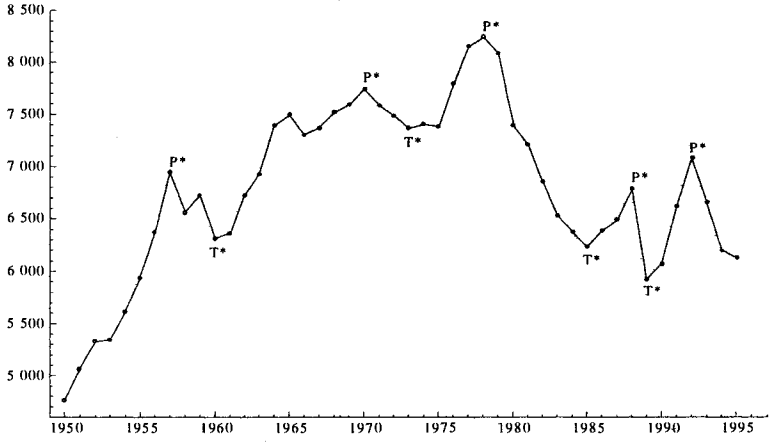

**Graph 8**

*Peru: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*




* Indicates turning points

**Graph 9**
*Venezuela: Real GDP Per-Capita (Original Series) and Turning Points, 1950-1995*




* Indicates turning points.

## 4. International Synchronisation of Business Cycle Regimes

In this section we follow the methodology suggested by Artis, Kontolemis and Osborn (1997) to study the synchronous nature of business cycles. We adopt a nonparametric procedure which ignores the magnitude of change and considers only the direction of underlying movement implied by the chronologies defined in the previous section. By doing so, we are able to measure the extent to which the cycles uncovered are contemporaneous international phenomena.

### 4.1. *Methodology*

The classical business cycle chronologies defined in the previous section are used to create a binary time series variable for each country, denoting years during expansion by zeros and recessions by ones. For a pair (country *i*, country *j*) over the sample period, we obtain a 2 x 2

contingency table recording expansions/recessions frequencies. Then, the following Person's corrected contingency coefficient, $CC_{corr}$ is estimated,

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

where

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

where $n_{ij}$, for $i, j = \{0,1\}$, represents the number of periods in which both countries 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 $CC_{corr}$ is equal to 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 countries. At the other extreme, complete dependence indicates that the two countries are in the same regime for every time period and hence have identical business cycle turning point dates (see Artis, Kontolemis, and Osborn, 1997, for further details).

### 4.2. *Results*

Preliminary information about the relationships among Latin American countries and the United States is presented in table 4. Conventional sample correlation coefficients for growth rates of real GDP per-capita over the period 1951-1995 are shown. We observe that most coefficients are small —the largest one refers to the relationship between Mexico and Bolivia (40.8%)— and range from -43.5 (for Brazil and Venezuela) to 40.8% .

We can establish some associations among the growth rates of these countries by considering arbitrarily that a correlation coefficient equal or less than 25% indicates "low" association. Then, we find associa-

**Table 4**
*Latin America: Sample Correlations Coefficients for Real GDP Per-Capita, 1951-1995*
*(Percentages)*

| | *Argentina* | *Bolivia* | *Brazil* | *Chile* | *Colombia* | *Mexico* | *Peru* | *Venezuela* | *United States* |
|---|---|---|---|---|---|---|---|---|---|
| Argentina | ... | 18.6 | 21.4 | 21.7 | 13.9 | 25.2 | 36.1 | 13.2 | 0.1 |
| Bolivia | 18.6 | ... | 23.2 | 12.9 | -24.8 | 40.8 | 15.0 | 19.4 | 32.4 |
| Brazil | 21.4 | 23.2 | ... | 0.0 | 37.6 | 13.1 | 28.4 | -43.5 | -1.2 |
| Chile | 21.7 | 12.9 | 0.0 | ... | 20.6 | 16.6 | 7.7 | -31.0 | 33.9 |
| Colombia | 13.9 | -24.8 | 37.6 | 20.6 | ... | 2.9 | 23.1 | -11.3 | 22.6 |
| Mexico | 25.2 | 40.8 | 13.1 | 16.6 | 2.9 | ... | 3.9 | 15.2 | 1.7 |
| Peru | 36.1 | 15.0 | 28.4 | 7.7 | 23.1 | 3.9 | ... | 10.7 | -0.1 |
| Venezuela | 13.2 | 19.4 | -43.5 | -31.0 | -11.3 | 15.2 | 10.7 | ... | 11.8 |
| United States | 0.1 | 32.4 | -1.2 | 33.9 | 22.6 | 1.7 | -0.1 | 11.8 | ... |

tions between some pairs of countries which are not extended to third countries. For example, there is some association between Argentina and Mexico, and Argentina and Peru, but the association between Mexico and Peru is low. Analogous evidence is presented for Bolivia-Mexico and Bolivia-US, and Brazil-Colombia and Brazil-Peru. On the other hand, the negative relationship between Brazil and Venezuela (and Venezuela-Chile and Venezuela-Colombia, which are very small) is strange. Also we find that economic growth in Chile is not related to growth in other Latin American countries and that its greatest correlation coefficient relates to the United States. Finally, we do not find strong association between Venezuela and any other country —except the negative correlation with Brazil that we mentioned above. Thus, so far, we do not find evidence of important associations between the growth rates of Latin American countries in general and between the growth rates of members of the Andean Group and Mercosur.

Next we present the Pearson's corrected contingency coefficients for the same group of countries analysed above according to expressions (1) and (2). In the calculations, we do not restrict our analysis to complete cycles. For the period prior to the first observed turning point and for the period subsequent to the last observed turning point, we decide whether each economy was in recession or expansion according to the observation of the slope of real GDP per-capita and according to the requirements of the AKO methodology about the difference between

**Table 5**
*Latin America: Pearson's Corrected Contingency Coefficient for Complete Sample, 1951-1995*
*(Percentages)*

| | *Argentina* | *Bolivia* | *Brazil* | *Chile* | *Colombia* | *Mexico* | *Peru* | *Venezuela* | *United States* |
|---|---|---|---|---|---|---|---|---|---|
| Argentina | ... | 54.2 | 67.3 | 9.9 | 22.4 | 36.6 | 41.6 | 29.1 | 7.9 |
| Bolivia | 54.2 | ... | 37.2 | 5.4 | 39.8 | 51.7 | 5.4 | 33.9 | 35.5 |
| Brazil | 67.3 | 37.2 | ... | 4.4 | 17.9 | 7.5 | 83.4 | 16.5 | 42.0 |
| Chile | 9.9 | 5.4 | 4.4 | ... | 9.6 | 0.9 | 14.1 | 3.4 | 31.5 |
| Colombia | 22.4 | 39.8 | 17.9 | 9.6 | ... | 19.2 | 20.5 | 4.2 | 63.1 |
| Mexico | 36.6 | 51.7 | 7.5 | 0.9 | 19.2 | ... | 0.9 | 53.4 | 19.7 |
| Peru | 41.6 | 5.4 | 83.4 | 14.1 | 20.5 | 0.9 | ... | 12.5 | 14.1 |
| Venezuela | 29.1 | 33.9 | 16.5 | 3.4 | 4.2 | 53.4 | 12.5 | ... | 3.5 |
| United States | 7.9 | 35.5 | 42.0 | 31.5 | 63.1 | 19.7 | 14.1 | 3.5 | ... |

short-run erratic fluctuations and turning points. The calculations of the Pearson's corrected contingency coefficient based on the cycles defined according to the AKO methodology are reported in table 5. To characterise the associations among the classical business cycles across countries, we define arbitrary ranges for the Pearson's corrected contingency coefficient. 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 cycles.

We find strong associations only between the business cycles of three South American countries, namely, Argentina, Brazil, and Peru, especially for the following pairs: Brazil-Peru (83.4%) and Brazil-Argentina (67.3%) (although the association between Argentina and Peru is only mild, 41.6%). In addition, there is a strong association between the cycles of Colombia and the United States (63.1%). Mild associations are found for the business cycle of Argentina and Bolivia (54.2%), Bolivia and Mexico (51.7%), Mexico and Venezuela (53.4), and Brazil and the United States (42.0%).

The strong to mild association among countries like Argentina, Bolivia, Brazil, Mexico, Peru, and Venezuela might be explained by of the fact that they shared an industrialisation process based on the substitution of imports until the end of the 70s, faced a common external debt crisis in the early 1980s and then experienced stabilisation processes

and structural reforms during the 1980s and 1990s. When we observe graphs 2 to 9 we realise that Latin American countries had in common the expansion of the substitution of imports period; this fact might explain a significant proportion of the correlation among them. The lack of synchronisation, on the other hand, might due to differences in shocks experienced by each economy[15] as well as in policy responses to those shocks.[16]

The Pearson's corrected contingency coefficients are low for the association between both Chile and Colombia with all others, except that for the relationship between Colombia and the United States (63.1).[17] Thus, from a Latin American perspective, it seems that the business cycles of these two countries are idiosyncratic. Analogously, it is important to point out that the US business cycle does not show important direct association with the business cycles of others Latin American countries, though potential affects might be transmitted throughout the Brazilian economy.

Because we are working with countries of different sizes, it would interesting to know whether there exist some association between smaller and larger economies. To do so, we depict different combinations of the associations with the three largest Latin American economies, namely Argentina, Brazil, and Mexico, for the period 1951-1995. First, we show the associations with the two largest South American economies. Graph 10 plots the association of each country with Argentina against that with Brazil. We observe that 4 out of 6 Latin America countries show a low association with both countries. Only Peru is associated (at least mildly) with both Argentina and Brazil. The mild association of Bo-

[15] For example, the falls in mineral prices (especially of tin and copper) in the middle and late 1970s affected especially Bolivia and Chile while the increases in oil prices in the late 1970s benefited Mexico and Venezuela. The earthquake in 1985 and the fall of oil prices in 1985-1986 affected the Mexican economy negatively. In Peru, the natural phenomenon called "El Niño" caused droughts and floods in 1983 while the guerrilla group "Sendero Luminoso" intensified its attacks in the second half of the 1980s in Peru. These are only some examples of shocks experienced in some Latin American countries that contributed to their recessions.

[16] See Edwards (1995) for an overview of the stabilisation process and the structural reform during the 1980s and 1990s.

[17] However, it is important to point out that most of this association might be due to the coincidence that the only recession faced by Colombia during this period coincided with one in the United States between 1956 and 1958. At any other date, Colombia has been permanently in expansion, which is not the case of the US.

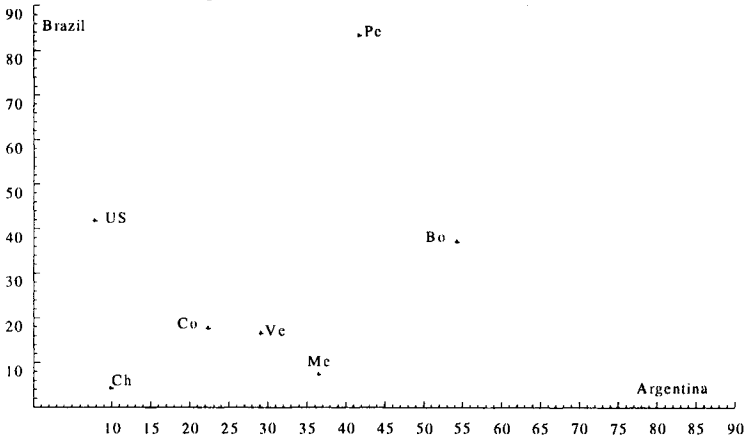
livia with Argentina and of the US with Brazil, can also be observed. In graph 11 the associations with Argentina and Mexico are plotted. On the right side of the graph, we can see the association among the South American countries whose business cycle is not idiosyncratic: Argentina, Bolivia, Brazil, and Peru. Mexico, in turn, is only associated with Venezuela and Bolivia (mild association). Graph 12 —for the associations with Brazil and Mexico—, shows that the associations of South American countries are not of the same for all four countries. In particular, Bolivia has a low association with Brazil. Finally, graph 13 plots the association of each country with Brazil —that is the largest Latin American economy— against that with the US. We observe that, except for Colombia, Latin American business cycles have weak association with the US business cycle. We observe again the strong association between the Peruvian and the Brazilian business cycle regimes as well as the mild association between the Argentinean and the Brazilian business cycle regimes.

Some qualitative comparison of our results with the findings of other studies can be done. Our results are consistent with those of Arnaudo and Jacobo (1997), who find the only important correlation within Mercosur to be that between the cyclical fluctuations of Brazil and Argentina. Our findings are also consistent with those of Engle and Issler (1993) who find common features between the cyclical fluctuations of Argentina and Brazil; however, we differ from them because we do not find significant associations between the cyclical fluctuations of these countries and those of Mexico. In addition, our results are consistent in some sense with the findings of Iguíñez and Aguilar (1998) who do not find significant correlations among Andean Group countries over the post-debt crisis period. That period is included in our calculations of the Pearson's contingency coefficient, and we find low associations between the business cycle regimes for the Andean Group countries considered in this study over the whole sample period.

It is convenient to point out that these two trade agreements are quite recent and that Latin American growth before the generalised crisis was largely supported by protectionist policies. Thus international trade within the region does not seem to be significant. This suggests that the existing synchronisation of international business cycles are not the result of international transmission, but a result of common shocks (mainly the external debt crisis of 1982) and/or similar economic policies (mainly the import substitution strategy of the 1950s, 1960s and

## Graph 10

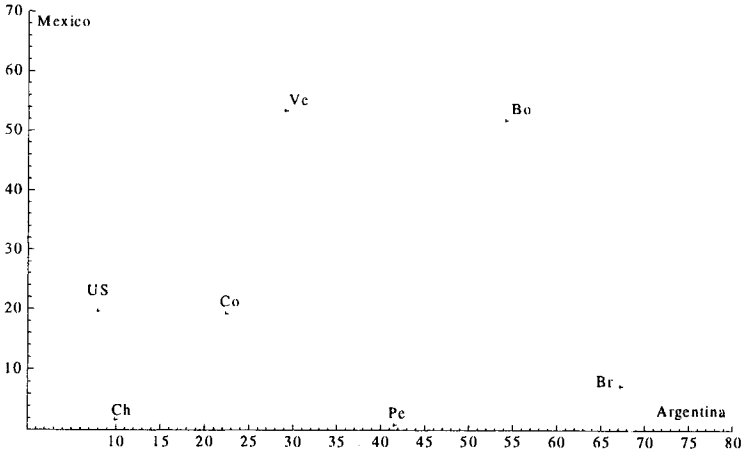
*Latin America: Business Cycle Regimes Associations with Respect to Argentina and Brazil, 1951-1995*




Source: Table 6.

## Graph 11

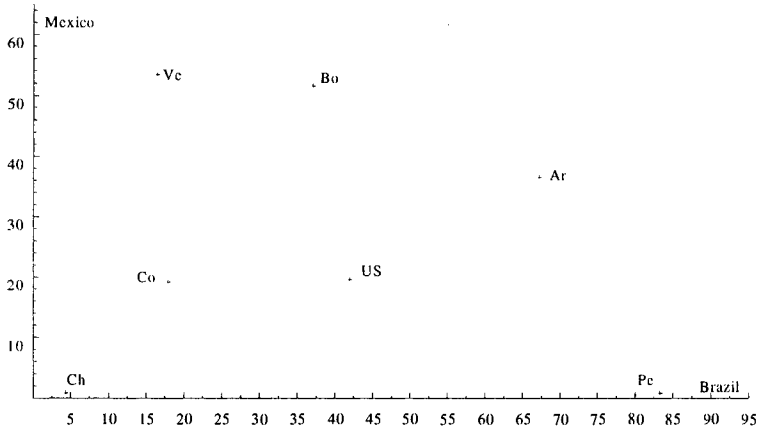
*Latin America: Business Cycle Regimes Associations with Respect to Argentina and Mexico, 1951-1995*




Source: Table 6.

**Graph 12**

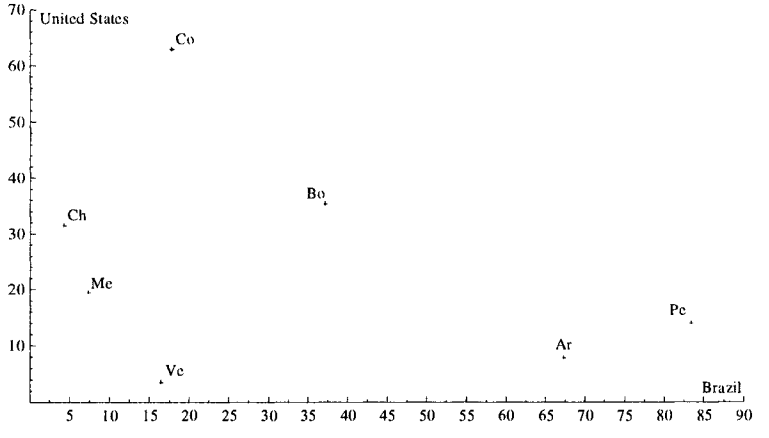
*Latin America: Business Cycle Regimes Associations with Respect to Brazil and Mexico, 1951-1995*




Source: Table 6.

**Graph 13**

*Latin America: Business Cycle Regimes Associations with Respect to Brazil and the United States, 1951-1995*




Source: Table 6.

1970s as well as the restrictive stabilisation policy of the 1980s and 1990s). This conclusion is consistent with the evidence presented by Canova and Dellas (1993), who find that for some developed countries international trade has moderate cyclical macroeconomic effects and its role in the transmission of economic disturbance is modest as well. Furthermore, they argue that in the post oil-shock period of 1973, most international business cycles are explained by common external shocks. Krolzig (1997) draws similar conclusions. Engle and Issler (1993), on the other hand, suggest that external shocks have played an important role in Latin American economic performance.

## 5. Final Remarks

We have applied a classical business cycles methodology to date turning points, to analyse asymmetries over the business cycle, and to study international synchronisation of business cycles regimes in Latin America. An essential feature of this methodology is that it distinguishes between short-run declines and recessions and between short-run upturns and expansions.

The results suggest the existence of significant asymmetric behaviour for most of the economies analysed. In agreement with the considerations of Mitchell (1927), Keynes (1936), and Burns and Mitchell (1946) it is found that recessions are characterised by deeper change and less persistence than expansions. In addition, the results are consistent with the findings of Blanchard and Watson (1986) and Kähler and Marnet (1992) that volatility is also asymmetric over the business cycle. The implication of these findings is that these economies function differently in expansions and recessions, and these characteristics should be considered in the design of economic policies.

Also, we have found little evidence about the existence of a common Latin American business cycle. However, we have presented evidence of strong associations between the business cycles of Brazil and Peru and for Argentina and Brazil, and mild associations between the regimes of Argentina and Bolivia, Argentina and Peru, Mexico and Venezuela, and Brazil and the United States. Existing evidence about intra-regional trade and foreign investment suggests that, for Latin America, these associations might be explained by similar economic policies and common external shocks either during the long period of sustained

growth and during the period of stagflation rather than by international transmission of country specific shocks. It is reasonable to think that after recent free trade agreements and liberalisation of capital markets Latin American integration will increase, and that transmission mechanisms will play a more important role.

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## Appendix 1
## The Data Set

The Penn World Tables version 5.6 data set is used because of its homogeneity and the comparability of the data among different countries, and because it presents data for a reasonably long period.

The specific data set used for this paper is an updated version of that of Summers and Heston (1991); data are available for the period 1950-1992 and were taken from the *World Wide Web* site *http://www.bizednet.bris.ac.uk:8080/dataserv/pennhome.htm*. The period was extended to 1995 in order to consider the recent experience of Latin America, we considered this important to help analyse the consequences of the adjustment of the 70s and 80s.

To update the data we followed the methodology suggested by Summers and Heston (1991, p.343), which is summarise as follows:

> The simplest extrapolation is for RGDP ..., real per-capita GDP expressed in 1985 International prices. Its components, $C$, $G$, $I$, $X$ (exports), and $M$ (imports) are also per-capita and expressed in 1985 international prices. Supposed that all of the components are known for 1985 from the ICP (International Comparison Program). The corresponding component values for any other year are obtained by applying the relevant growth rates from the constant-price national accounts series -the values for the year of interest divided by the corresponding 1985 ones- to the 1985 numbers. Then, the RGDP for the new year, still in 1985 international prices, is simply the national accounting sum of the extrapolated components. Thus, RGDP for 1985 can be extrapolated to any year covered by the national accounts...

The data sources were the following:

1. Real gross domestic product per-capita (1985 international prices; *Laspeyres Index*), 1950-1992: *World Wide Web* site mentioned above.

2. Aggregate values of GDP, private consumption, general government consumption, exports and imports of goods and NF services: 1985-1992, World Bank, data set in diskette, 1993, World Bank (1985), *World Tables.*

Growth rates of the aggregate values of real GDP, private consumption, general government consumption, exports and imports of goods and NF services: 1994-1995, World Bank, *Trends in Developing Countries*, 1996 and 1997.

Population 1985-1995, International Monetary Fund (1997), *International Financial Statistics. Yearbook.*

## Appendix 2
## Methodology for the Determination of Turning Points

This methodology is an annual version of the methodology used by Artis, Kontolemis and Osborn (1997, Appendix C) who applied it to montly data. The detailed methodology is as follows:

1. Determination of extreme values.
2. Determination of cycles in 3-years moving average.
   *a)* Identification of points higher (lower) than 1 year on either side.
   *b)* Enforcement of alternation of turns by selecting the highest of multiple peaks (lowest of multiple troughs).
3. Determination of turning points on unsmoothed series.
   *a)* Identification of points higher (lower) than 1 year on either side.
   *b)* Enforcement of alternation of turns by selecting the highest of multiple peaks (lowest of multiple troughs).
   *c)* Identification of flat segments.
   *d)* Identification and exclusion of "outliers" from "possible" turning points.
   *e)* Enforcement of alternation of turns by selecting the highest of multiple peaks (lowest of multiple troughs).

*f)* Identification of "short cycles" (less than 3 years from peak to peak or trough to trough).

*g)* Minimum amplitude rule requiring the amplitude of a phase (peak to trough or trough to peak) be at least as large as 1 standard error of log changes.

4. Comparison of tentative turning points selected for smoothed and original series.

*a)* Exclusion of "possible" turning points of unsmoothed series that do not correspond to similar turns ( ± 3 years) of the moving average.