Production and Unemployment Cycles in the Caribbean: The Case of Barbados and Trinidad and Tobago

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Abstract:
This paper investigates some of the topics related to the discerning of trends and cycles in production and unemployment data of the Caribbean economies of Barbados and Trinidad and Tobago. Using the Hodrick-Prescott and Baxter-King filters, this study proposes a chronology and a description of some of the cyclical properties of these series. Next, it examines the causality relationships that combine these variables. Empirical evidence from the cross-correlation coefficients indicates that the unemployment rate leads the cycle in both countries. A test of Okun's Law suggests that it may not be very relevant in these two economies and hence, may not be a correct measure of unoccupied resources.

1. Introduction

Business cycles, which can be succinctly defined as recurrent fluctuations in aggregate economic activity, have occupied the interest of macro economists because their understanding has important policy implications. For instance, because economic disequilibria can either be temporary or permanent, the ability of the policy analyst to accurately pinpoint not only an economy's position in its business cycle, but also an estimate of its length is a definite advantage when developing strategies to correct these imbalances during the design of stabilisation and adjustment programmes (see Agénor and Montiel, 1996).

Researchers have developed a wide range of econometric and statistical techniques of documenting the empirical regularities of business cycles. From the existing literature, different theories have emerged that, for the most part, explain a business cycle as a natural outcome of an economic system. Modern real business cycle (RBC) theory defends the idea that cycles arise as an equilibrium outcome of the activities of rational economic agents, are characterised by the strong focus on technology shocks as the driving forces of fluctuations in economic activity, and are dominated by propagation mechanisms utilised to spread the effects of these shocks overtime (see Lucas, 1976; Kydland and Prescott, 1982; Long and Plosser, 1983). In essence, modern RBC theorists test competing postulates of the sources and propagation mechanisms of the cyclical fluctuations by comparing how different models mimic important aspects of the cyclical behaviour of actual economies through time. Unfortunately, as noted by Agénor, McDermott and Prasad (2000), most of the research in this area has been limited to developed countries. This is primarily because of the low quality and frequency of economic data in developing countries. Moreover, these countries are more susceptible to sudden crises and marked changes in macroeconomic variables, thus obscuring proper identification of any cycle or economic regularity in their data sets.

In light of the above, empirical studies for developing economies are a welcomed contribution to the debate of how best to explain fluctuations in macroeconomic variables, such as production and employment. Although some work has been done on Latin America, Africa and Asia (see Agénor, McDermott and Prasad, 2000; Belaisch and Soto, 1998; Kydland and Zarazaga, 1997; Rodriguez-Mata, 1997) no studies have been undertaken for Caribbean territories. Therefore, this article attempts to fill this lacuna by focusing on two small, open, but diverse economies: Barbados (a tourism-oriented economy) and Trinidad and Tobago (an oil-dependent economy). These countries were also chosen because of their relative economic stability and the availability of quarterly output data.

More specifically, this paper seeks answers to these questions: What sequencing technique should be employed to identify major cyclical movements in the real Gross Domestic Product (GDP) of Trinidad and Tobago and Barbados? What are the cyclical properties of the Barbados and Trinidad and Tobago real GDPs? Is it possible to identify and describe the cyclical factors affecting the level of unemployment? How can structural and cyclical unemployment be characterised for Barbados and Trinidad and Tobago? What is the relationship between the cycles of unemployment and output in these two countries?

Following this introduction, the paper continues with a brief discussion of the concepts and methodological principles of the techniques used. Data issues are provided in section three and the econometric results are in section four. Section five describes the causal relationships between the production and unemployment cycles for the two countries examined. Conclusions are presented in the final section.

2. A Brief Overview of Concepts and Methodological Principles

Macroeconomists have differing opinions on how to interpret the evolution of a variable in terms of its long-term path (growth) and its short-term dynamics (fluctuations). As Abraham-Fois (1991) points out, the definitions proposed for the different phases of the business cycle have continued to evolve throughout the twentieth century. In the early years, the cycle was represented as a succession of phases in the following order: crisis, depression, recovery, and so on. Then, during the 1920s, the concept of "recession" became more popular than that of "crisis". In the 1930s, the Nine-Point Cycle method was developed to give a definitive picture of the various phases of cycles. Between the 1940s and 1980s, the various methodologies suggested for the observation of cycles relied heavily on Burns and Mitchell (1946) description of business cycle fluctuations, which are characterised as durations of expansion and contraction and the timing of turning points. Since the end of the 1980s, however, the need to compare and contrast RBC models with the stylised facts made the rigorous calibration of cycles common practice. Following Lucas (1977), RBC theorists started to think of the business cycle as the deviations of aggregate real output from its long-term trend, and business cycle regularities as the dynamic co-movements of the cyclical components of key economic variables. From this basis, the variances, auto-correlations and dynamic cross-correlations of the cyclical components of real output and other economic variables were calculated in order to quantify the qualitative characteristics of the cycle. These statistics are, respectively, the phenomena of relative variability, persistence and covariance (Hairault, 2000). This way of measuring business cycles is standard in the empirical literature on historical cycle fluctuations and is discussed in more detail below. Also, for a comparison of the graphical methods and the more quantitative measures, see Harding and Pagan (2002).

2.1 Measuring the Business Cycle

The path observed for the initial series x_t is assumed to be the result of a combination of different unknown contributing factors, whose movements may be simulated by the following additive model:

$$x_t = T_t + C_t + e_t \qquad (1)$$

with T_t, C_t and e_t representing the trend, cyclical and irregular components, respectively. How can the trend and cyclical components each be identified and separated? In fact, depending on the mathematical hypotheses used to define the spectral characteristics of the trend and the cycle, a number of different approaches could be taken to obtain the unobserved trend and cycle in Equation (1). One such approach entails the filtering out of all the components, carefully distinguishing between those associated with low frequencies (in order to determine the trend) and those related to high frequencies (isolating the cyclical component). For instance, in the case of quarterly variables, long-term movements in the trend may be more than 32 quarters in duration, while short-term movements may be between 6 and 32 quarters in length for the cycle and less than 6 quarters for the irregular component (see Burns and Mitchell, 1946).

Another less-demanding technique, and the one used in this paper, is to isolate the trend term (T_t) and then consider C_t as an estimate of the business cycle component. This procedure conforms to the above-mentioned Lucas' (1977) definition of the business cycle as "movements about a trend in Gross National Product".

Several methods are available to separate the cyclical movement, but the one often chosen is that of Hodrick and Prescott (1980), which involves the minimisation of a weighted sum of two terms. The first term corresponds to the variation in the cyclical component, represented by the difference between the raw series and the trend, and the second term, the variation of the growth rate from the trend. In formal terms, the programme to be solved is:

$$Min\{Var(x_t - T_t) + l\,Var(\Delta T_{t-1})\} \tag{2}$$

which is equivalent to:

$$Min\left\{\sum_{t=1}^{n}(x_t - T_t)^2 + l\sum_{t=3}^{n}\left[(T_t - T_{t\text{-}1}) - (T_{t\text{-}1} - T_{t\text{-}2})\right]^2\right\} \tag{3}$$

The parameter l weights the importance of the second term relative to the first, and can be interpreted as the opportunity cost of introducing fluctuations in the trend. If $l = 0$, then the solution of Equation (3) is $T_t = x_t$, and the trend coincides with the raw series. Conversely, if l tends to infinity, the minimum is obtained for $\Delta T_t = T_t - T_{t-1}$= constant (the trend is linear). For $l \in [0, +\infty]$, this "filter" has a modulating effect on the cyclical component if s_1 and s_2 are denoted as the standard errors of T_t and $(x_t - T_t)$, respectively, and Equation (3) may then be re-written as:

$$\text{Min}\left\{s_1^{-2}\sum_{t=1}^{n}(x_t - T_t)^2 + s_2^{-2}\sum_{t=3}^{n}\left(D^2 T_t\right)^2\right\}$$

where $l = s_2^2 / s_1^2$ and $\Delta^2 T_t = (T_t - T_{t-1}) - (T_{t-1} - T_{t-2})$. Here l is clearly shown as dividing the total fluctuations into long-term and short-term fluctuations, with its value determined by the observed fluctuations. Hodrick and Prescott (HP) established a value of $l = 1600$ for quarterly USA data, while Ravn and Uhlig (2002) derived a value of $l = 6.25$ for annual USA data.

From a purely practical point of view, the solution of Equation (3) is obtained from the first-order condition by differentiating with respect to T_t. With the introduction of the lag operator L, this solution leads to an analytical expression for the cyclical component $C_l = x_t - T_t$ (see Pedersen, 1999):

$$C_t = \left[\frac{l\,(1-L)^2 \left(1-L^{-1}\right)^2}{l\,(1-L)^2 \left(1-L^{-1}\right)^2 + 1} \right] x_t \tag{4}$$

One interesting property of this HP filter, revealed by this equation, is that, it eliminates the non-stationary components of x_t, whose order of integration is less than or equal to four.

Notwithstanding its practicality and applicability, some studies have alluded to deficiencies in the HP filter, most notably those of Harvey and Jaeger (1993) and Cogley and Nason (1995). The main limitations cited were: (i) the arbitrary choice of the parameter l gives equal weighting to a cyclical variation of 5% and a 1/8% change in the growth rate; (ii) when estimating the trend, the HP filter does not distinguish between short-term fluctuations, which may be interpreted in terms of the economy (the cycle) and those that cannot be explained (errors in measurement) and; (iii) the tendency of this process to deform the dynamic properties of the data by introducing spurious cycles.

Given these deficiencies, other authors have proposed alternative filters that better identify the stylised facts of the cycle. For example, Baxter and King (1995) – hereafter BK – suggested a band-pass filter of finite order *K*, which is a moving-average approximation of an ideal band-pass filter. With trend-reducing properties and symmetric weights, this specification ensures that there is no phase shift in the filter output. A major advantage of this filter is its ability to extract from the data those fluctuations that are within a certain range of frequencies and, in particular, those that characterise the cycle, which are 6 to 32 quarters in duration. This method can be developed formally as follows: let x_t and y_t be, respectively, the original and filtered series related by

$$y_t = \sum_{i=-K}^{K} a_i L^i x_t \tag{5}$$

The weights a_i where $i = 1, 2, \ldots, K$, are determined by applying a Fourier transform $a(w)$ to Equation (5). Their values are determined through solving the following programme:

$$\underset{a_i}{Min}\, Q = \int_{-p}^{p} \left| b(w) - a(w) \right| dw \tag{6}$$

$\beta(\omega)$ denotes the ideal filter gain with cut-off frequencies w_1 and w_2, so $b(w)-a(w)$ is the discrepancy arising from the approximation at frequency w. The solution is given by:

$a_i = b_i + q$, where $i = 0, \pm 1, \pm 2, \ldots, \pm K$, and

$$b_i = \begin{cases} \dfrac{w_2 - w_1}{p} & \text{if } i = 0 \\ \dfrac{1}{p_i}(\sin w_2 i - \sin w_1 i) & \text{if } i = 0, \pm 1, \pm 2, \ldots, \pm K \end{cases} \tag{7}$$

$$q = \frac{-\sum_{-K}^{K} b_i}{2K+1}$$

At the practical level, since the BK filter is defined as a centered moving average of order *K*, it has the disadvantage of losing data at the beginning and ending of the series. With the value *K* = 12, usually recommended for quarterly observations, 6 years of data are lost, 3 at each end of the series. However, this lost-of-data problem is usually rectified using backcasting and forecasting techniques.

In the literature, the application of the BK filter to time series, other than direct indicators of growth like GDP and the index of industrial production, is becoming increasingly common, as are studies comparing this filter with other filters (see, for example, Fournier, 1999; Agénor, McDermott and Persad, 2000).

2.2 Identification of Cycles

After identifying the C_t series, the next step is to discern the cycles, which can be of two types: major cycles and minor cycles. In theory, a complete cycle can either be a parabola with a local maximum, which consists of an expansion followed by a contraction between two troughs, or an inverted parabola with a local minimum, characterised by a contraction and then an expansion between two peaks. However, in practice, an economy may evolve, over relatively long periods, without any clear picture of its cycle. Consequently, calculating the durations of the cycles for the relevant periods is a very complex technical procedure. Moreover, there is no single technique for undertaking this task.

The most popular method for the selection of turning points was developed by Bry and Boschan (1991). This method, which has been employed for decades by the National Bureau of Economic Research in the US, consists of the *ad hoc* encoding of filters under rules devised by Burns and Mitchell (1946). It operates on the original data and isolates local minima and maxima in a time series, subject to constraints on both the length and amplitude of expansions and contractions. The procedure utilised in this paper is similar to Bry and Boschan, except that the data used is detrended. In essence, with respect to major cycles (periods of fluctuation from trough to trough), this procedure consists of an iterative process whereby: (i) the minimum point for the entire period is identified; (ii) this point is bounded by the nearest and highest peaks; (iii) the trough that is deepest and closest to the peak recently identified in (ii) is located; and (iv) the procedure is repeated. To determine the minor cycles the same method is followed for a sub-period bounded by two major troughs. To avoid overlapping, the principle is established that a cycle ends in a trough and begins immediately after the trough of the previous cycle. Likewise, in order to remain true to the Burns and Mitchell definition, the phases of a given cycle (that is, periods of recession and expansion) must be chosen in such a way that their total duration is equal to that of the cycle.

It is now clear that the ability of all quantitative methods to provide good results for the identification of cycles depends on the correct identification of the turning points in the cycle, that is, its peaks and troughs. Any error in their identification, which may be due to significant irregularities (captured by the residual component) or to a phase shift (artificial time-lag), leads to an erroneous measurement of the duration of the business cycle. Therefore, the various statistical and econometric techniques employed to describe, decompose and predict the movement of economic variables may give different results. This is what Fayolle (1996) was referring to when he wrote that "not only the mean of the cycle, but the second-order statistical movements (variance and temporal auto-covariance) of the trend and cyclical components, as well as their function in response to an exogenous factor, depend heavily on the method used". One must, therefore, display great dexterity when using these techniques.

3. Data and Stylised Facts

The raw data of the quarterly time series used in the empirical investigations spans the three decades of the 1970s, 1980s and 1990s, and were compiled from heterogeneous sources. For Trinidad and Tobago, the common data set was available over the sample period of 1971Q1 to 1998Q4. The real GDP series is computed from annual data published by the Central Statistical Office (see Watson, 1997) and the unemployment rate data were procured from various issues of the Annual Labour Force Report. In the case of Barbados, the shared data covers the period 1975Q1 to 2000Q4. Real GDP is an updated version of Lewis (1997), while the unemployment rate data was sourced from the Continuous Household Labour Force Survey undertaken by the Barbados Statistical Service. Unless otherwise stated the software programme RATS 4.31 was used for the estimations.

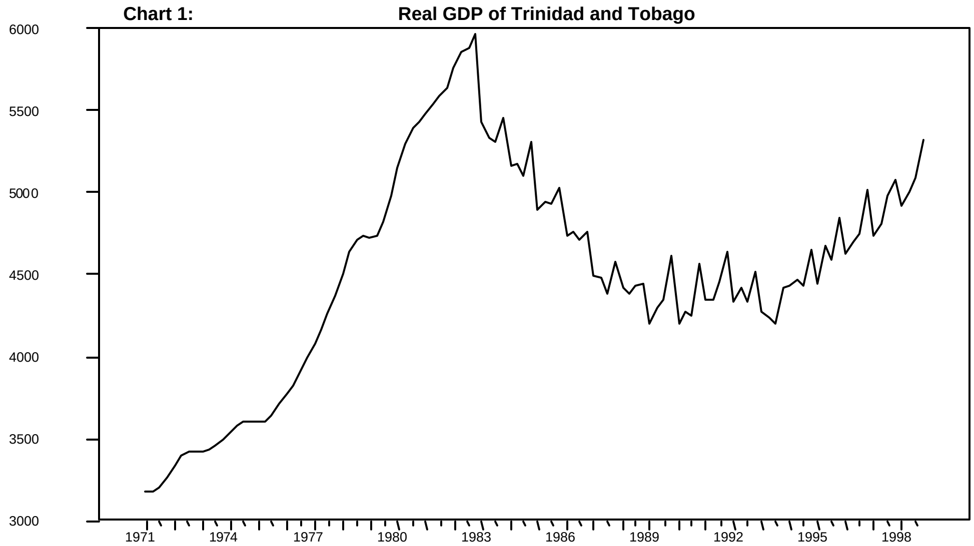
3.1 The Real GDP Series

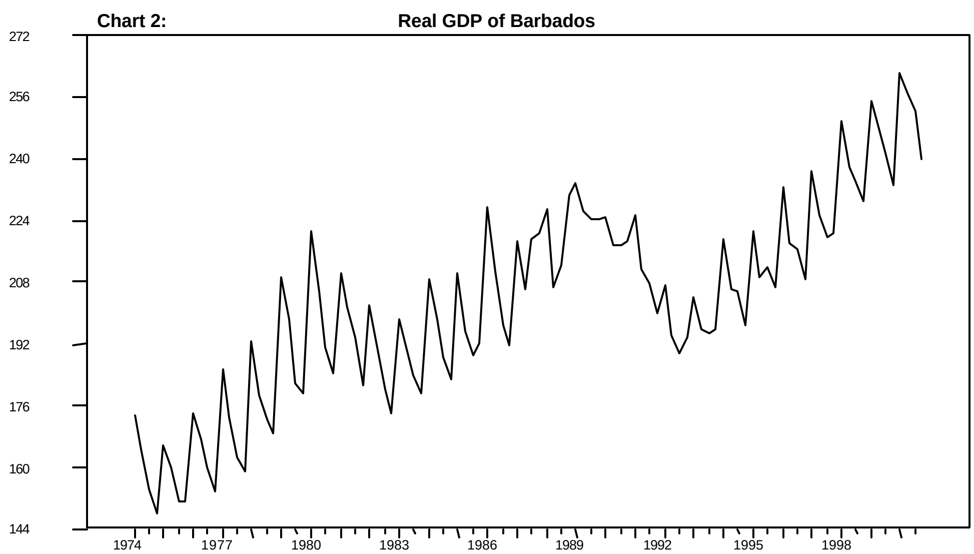
As seen in Chart 1, real output in Trinidad and Tobago grew rapidly over the period 1971-1982. In 1982, this upward growth trend halted, with real GDP falling from TT$5,964 million in 1982Q4 to TT$5,311million by 1984Q4, mainly because of the decline in international oil prices in 1983. Since that time, Trinidad and Tobago's real GDP contracted each year up to 1989. In fact, between 1980 and 1990, an average annual decrease of 4.7% was recorded in contrast to an average yearly increase of 5.9% between 1970 and 1980.

Real GDP growth resumed in 1990, with expansions of 1.7% that year and 3.1% in 1991. This period of recovery was partly explained by the hike in oil prices associated with the Persian Gulf War. However, in 1992, with the conflict over in the Middle East, oil production declined once again, resulting in negative growth rates up to 1993. From 1994 onwards, Trinidad and Tobago's real GDP has generally followed an upward trend.

With respect to Barbados, real GDP grew during the first quarter of every year over the period 1974 to 2000 (see Chart 2), indicating that economic activity, primarily due to the lucrative winter tourist season and sugar production, reaches its peak during Q1 of each year. A more detailed analysis of the trend in Barbadian real GDP identifies three distinct sub-periods. The first, which extends from 1974 to 1986, reveals that for almost the entire sub-period (eleven of thirteen years), production contracted in Q2, Q3 and Q4, the decline was less pronounced between Q2 and Q3, and in Q4, real GDP tended to decrease on average, to approximately 10% of its Q1 level. During the second sub-period, from 1987 to 1991, real GDP exhibited less year-to-year fluctuations than in the first sub-period. In fact, in 1987 and 1988, expansions were registered between Q2 and Q3 and between Q3 and Q4. In 1989 and 1990, increases were recorded for the first three quarters of each year. The year 1991 had a similar pattern to the preceding period.

The third sub-period, which covers the years between 1992 and 2000, exhibits some similarity between the quarterly trends of the first sub-period. There was a systematic decrease in real GDP in the second quarter of each year, except in 1995. Furthermore, output declined in Q3 and Q4 of each year, except in 1992, 1993 and 1997.





3.2 The Unemployment series

Chart 3 shows that in the case of Trinidad and Tobago the trend in unemployment is characterised by significant fluctuations, particularly after 1989. Between 1970 and

1972, unemployment increased by 43.5%, but later declined in 1973 and 1975 from 69.8 thousand in Q1 of 1973 to 51.6 thousand in Q4 of that year, and from 60.8 thousand in Q1 of 1975 to 57.6 thousand in Q4. Conversely, 1974 and 1976 represented periods of recovery due to the revenue effects of rising oil prices.

During the period 1977 to 1983, there was a general downward trend in the unemployment rate. From 1983 to 1989, this trend abated as extremely high growth rates in unemployment were recorded. For example, in 1984, 1985 and 1987 the unemployment rates went up to 27.6%, 16.3% and 31.5%, respectively. These large increases continued into 1988, when unemployment reached approximately 100 thousand. In 1990-91, employment rebounded somewhat, but this improvement was short-lived, as job losses rose once again because the world economy went further into recession.

An inspection of Chart 4 reveals that the unemployment rate in Barbados appears relatively unstable with a growth path that can be separated into three phases. The first phase spans the six-year period 1975-1981. In 1975, after reaching an alarming 22.5%, the unemployment rate gradually declined to its third-lowest level of 10.8% in 1981.

Between 1982 to 1991, the unemployment rate varied significantly, first increasing from 11.4% in 1982Q1 to 19.8% in 1985Q3, then fluctuating just over 15% until 1989Q3, after which it contracted marginally until 1990Q4.

Chart 3: The Unemployment Rate of Trinidad and Tobago

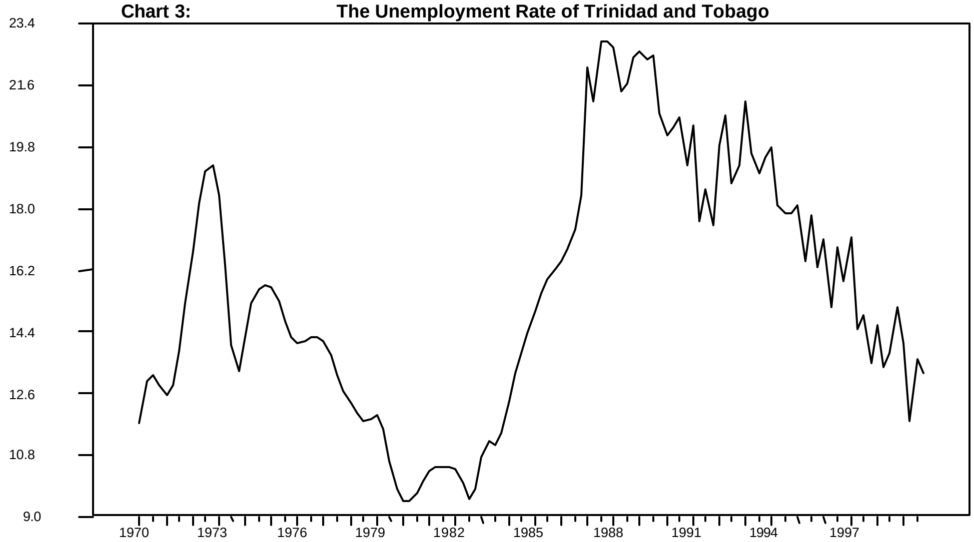
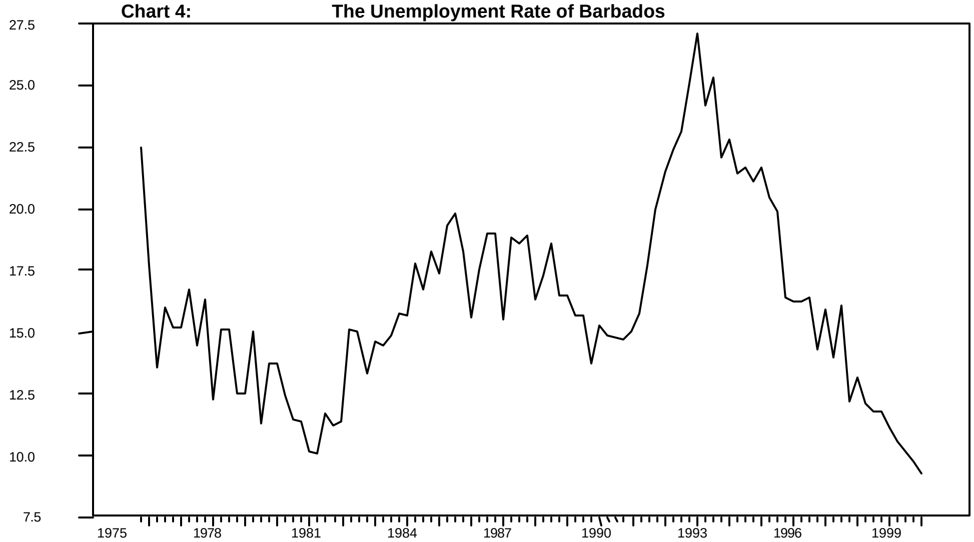


Chart 4: The Unemployment Rate of Barbados



The third phase, which relates to the period 1991-2000, is parabolic in form. The upward-sloping portion represents the years 1991-93, a recessionary period for the Barbadian economy. This period was characterised by an eight percent salary cut for public workers, massive lay-offs and steady growth in the unemployment rate from

17.3% in 1990 to 23% in 1992, then to 25.1% in 1992Q4 and 27.1% in 1993Q1. Since year-end 1993, there has been a spectacular decline in the unemployment rate from nearly 30% in 1993 to 9.3% by 2000Q1. This drop reflected the combining effects of prudent policy actions, and a statistical correction to the labour force, resulting from emigration and adjustments made after the census found that previous adult population estimates were too low.

4. Econometric results

The HP and BK filters were applied directly to the raw data, without pre-testing for unit roots, to capture the cyclical component of the time series. This can be safely done because these filters have the remarkable property of rendering stationary any integrated process of up to the fourth order. With respect to seasonality, the HP filter encapsulated the seasonal movements in the irregular components, while these were eliminated by the BK filter. Nevertheless, when the profile of the time series exhibited seasonal movements, as was the case with the real GDP series, the X-11 seasonal adjustment programme in EVIEWS 4 was employed. This convention simply puts seasonality out of sight and out of mind. The merits and demerits of this process is discussed by Christiano and Todd (2002).

4.1 A Chronology of the GDP series

The cyclical components obtained from applying the HP and BK filters to the Trinidad and Tobago and Barbados data are presented in Charts 5 and 6. The major conclusion derived from a detailed visual inspection of these charts is that the two methods give very similar results.

Measuring the cycles in the data series was quite challenging for both countries. This was because of their erratic growth paths, imperfection, small amplitudes over long periods and the large number of turning points. Nevertheless, the empirical analysis was still able to be carried out under the constraint of using only cycles of between 6 and 32 quarters in agreement with the common definition of the business cycle.

Firstly, for Trinidad and Tobago, in accordance with the stylised facts previously summarised in this text, the most noticeable peak appeared at the third quarter of 1982. Peaks of much lower amplitudes were observed in the post–1982 period. The most pronounced troughs (1975Q3, 1987Q2, 1993Q4) exhibited amplitudes of almost the same magnitude.

In the case of Barbados, two very pronounced peaks were observed in the production cycle, in 1980Q1 and 1988Q4. Before 1980Q1, between 1980Q1 and 1988Q4, and especially after 1988Q4, the peaks were of smaller amplitudes. Conversely, a greater number of significant troughs were identified (1977Q4, 1982Q4, 1988Q2, 1992Q2), which were characterised by fewer disparities in their amplitudes. Chart 6 also identifies the periods where output was below its trend level (1974Q4 –1978Q4, 1981Q4 – 1987Q2, 1992Q1 – 1995Q2) or above its trend level (1979Q1 – 1981Q3, 1987Q3 – 1991Q4, after 1995Q2).

Chart 5: The Cyclical Component of Real GDP for Trinidad and Tobago: A Comparison of the Methods

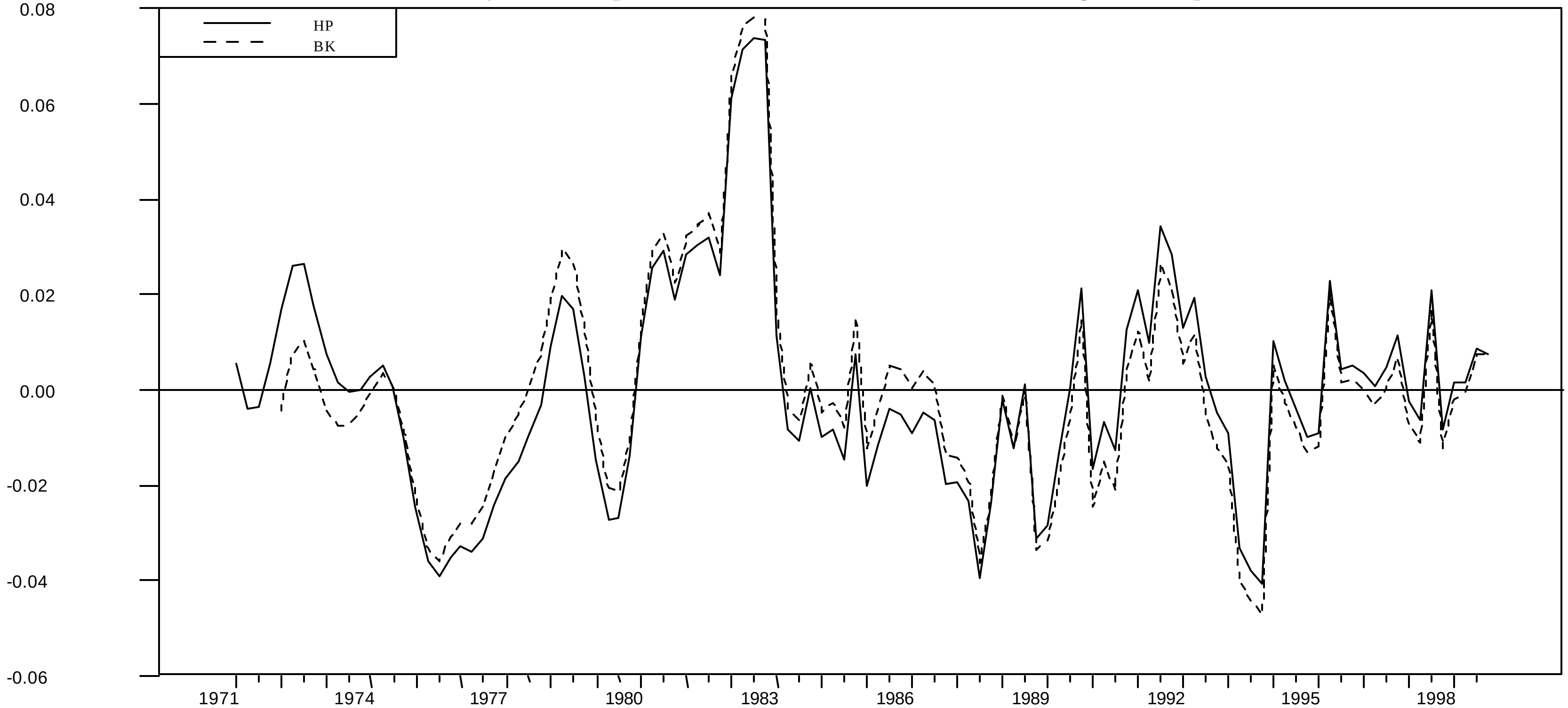
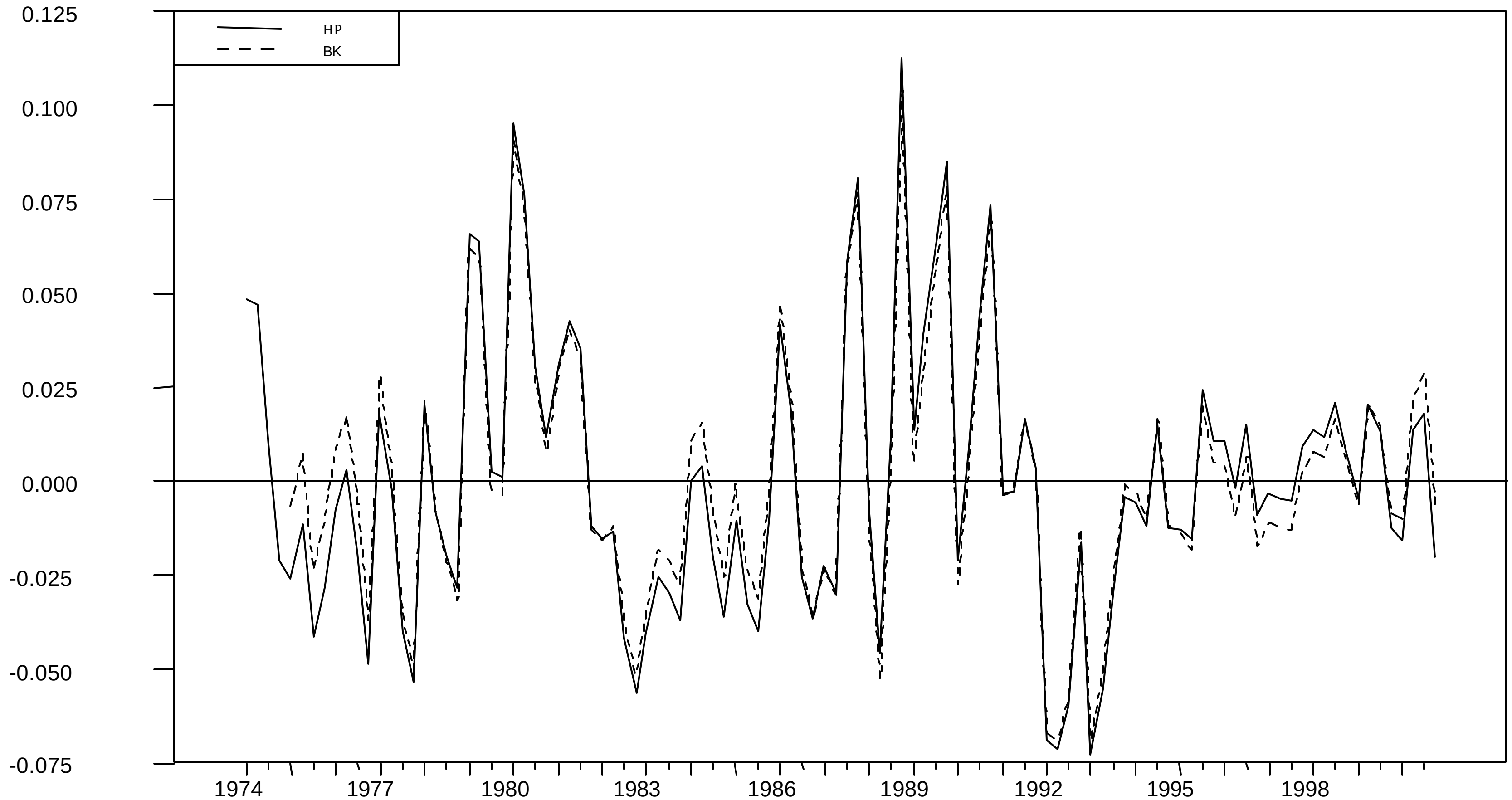


Chart 6: The Cyclical Component of GDP for Barbados: A Comparison of the Methods



Using the BK and HP filters revealed the existence of a Juglar or major cycle, with a duration of roughly thirty quarters (8 years), as well as Kitchin or minor cycles, whose duration is much shorter. Furthermore, the chronology selected appears to conform to the stylised facts previously summarised in the text.

Given the established chronology, two methods may be used to measure the duration of successive cycles: from trough to trough or from peak to peak. For Trinidad and Tobago, the former case reveals that the cycles are between 10 and 32 quarters in length and in the latter, they are between 7 and 29 quarters (Table 1). With respect to Barbados' real GDP, measuring from trough to trough, cycles of between 16 and 31 quarters were derived, while cycles of between 11 and 24 quarters were found using the peak to peak method (Table 2).

Table 1: Peaks and Troughs of Trinidad and Tobago Real GDP Cycle Between 1972 and 1998 (% Change in Real GDP)

	Troughs			**Peaks**		
Date	Amplitude		Time elapsed since last trough (in quarters)	Amplitude		Time elapsed since last peak (in quarters)
	HP	BK		HP	BK	
1972:3				0.32	0.13	
1975:3	-0.48	-0.44				
1978:2				0.23	0.35	23
1979:3	-0.32	-0.25	16	.		
1982:3				0.86	0.91	17
1987:3	-0.47	-0.43	32			
1989:4				0.26	0.17	29
1990:1	-0.20	-0.29	10			
1991:3				0.41	0.31	7
1993:4	-0.49	-0.56	11			
1995:2				0.27	0.24	15
1997:4	-0.10	-0.14	16			

Table 2: Peaks and Troughs of Barbados Real GDP Cycle between 1974 and 2000 (% Change in Real GDP)

	Troughs			Peaks		
Date	Amplitude		Time elapsed since last trough (in quarters)	Amplitude		Time elapsed since last peak (in quarters)
	HP	BK		HP	BK	
1974:1						
1977:4	-1.03	-0.97				
1980:1				1.82	1.73	24
1982:4	-1.07	-0.98	20			
1986:1				0.78	0.89	24
1988:2	-0.85	-0.97	22			
1988:4				2.09	1.93	11
1992:2	-1.34	-1.29	16			
1995:3				0.45	0.37	15
2000:1	-0.28	-0.18	31			

After dating the turning points, the computation of selected statistical indicators, such as the moments and autocorrelations of the cyclical component, is useful for investigation and comparison of the behaviour of the business cycles of different countries. In particular, the standard deviations, which measure the volatility in the data series, are expressed in the same unit as the cycle and the trend, thus allowing for easy comparisons. Therefore, according to the computed standard deviations in Table 3, the volatility in the business cycle is more pronounced in Barbados than in Trinidad and Tobago. Comparing the volatilities in the data series of Barbados and Trinidad and Tobago with other developing and industrial countries indicate, as one would expect, that there are in line with other developing countries (for example, compare with Agénor, McDermott and Prasad, 2000), but, however, much higher than the level typically recorded in industrial countries (for example, compare with Fournier, 1999).

The third and fourth moments of a distribution, skewness and kurtosis, unlike the standard deviation, are by construction non-dimensional moments. Therefore their interpretation is slightly different. For skewness, which characterises the degree of asymmetry of a distribution around its mean, positive values reflect the presence of a higher number of large values in the cyclical component, and vice versa for negative values. In other words, there are slightly larger peaks than troughs in the GDP of both countries. The kurtosis, which measures the relative peakness or flatness of a distribution, indicates that the GDP of both countries displays frequent large movements. As shown in Table 3, the kurtosis of Trinidad and Tobago is thrice the size of Barbados.

The autocorrelations measure the persistence of business cycles fluctuations. The values of the autocorrelations are generally positive for Trinidad and Tobago, suggesting a stronger persistence in the cyclical components of Trinidad and Tobago. These results are very similar to those found by Agénor, McDermott and Prasad (2000) for other developing countries, and confirm the view that the short-term fluctuations of Barbados and Trinidad and Tobago can be interpreted as business cycles.

Table 3. **Summary Statistics of the Cyclical Components of Real GDP of Barbados and Trinidad and Tobago**

	Standard Deviation	**Skewness**	**Kurtosis**	**Autocorrelations**					
				Lag 1	**Lag 2**	**Lag 3**	**Lag 4**	**Lag 5**	**Lag 6**
Barbados									
HP	0.04	0.64	0.63	0.49	-0.10	-0.22	0.48	-0.13	-0.07
BK	0.03	0.64	0.81	0.41	-0.02	-0.14	0.47	-0.09	-0.12
Trinidad and Tobago									
BH	0.02	0.83	1.71	0.78	0.58	0.39	0.27	0.22	0.14
BK	0.02	1.08	2.63	0.78	0.59	0.40	0.28	0.25	0.16

The existence of these cycles means that both the Barbados and the Trinidad and Tobago GDPs recorded regular phases of acceleration and deceleration (more visible in Trinidad and Tobago), characteristic of their main areas of economic activity – tourism services and petroleum products, respectively.

4.2 A Chronology of the Unemployment Series

In addition to production indicators, such as GDP and the industrial production index, the unemployment rate is also a key variable on which univariate econometric techniques can be applied on theoretical grounds. Indeed, an examination of the intrinsic dynamics of the unemployment rate provides some evidence of its volatility and seasonality. Firstly, a high degree of volatility suggests that unemployment acts as a correcting variable, thereby, allowing for the rapid adjustment of economic activity to fluctuations in aggregate demand. Thus, employment gains and losses could be adjustment factors between the labour force and the demand for labour. Secondly, seasonality in unemployment mirrors labour market activity, for example, firms find it easier to lay off workers in some sectors like agriculture and tourism, where labour is more flexible. These observations provide a strong basis for looking at the trend-cycle decomposition in order to identify the sequence and measure the amplitude of unemployment cycles.

As observed when applied to the real GDP series, the BK and HP filters of the unemployment data give quite similar results (see Charts 7 and 8). In the case of Trinidad and Tobago, Chart 7 shows that the amplitudes of the troughs appear to be more uniform than those of the peaks.

Chart 7: The Cyclical Component of Unemployment for Trinidad and Tobago: A Comparison of the Methods

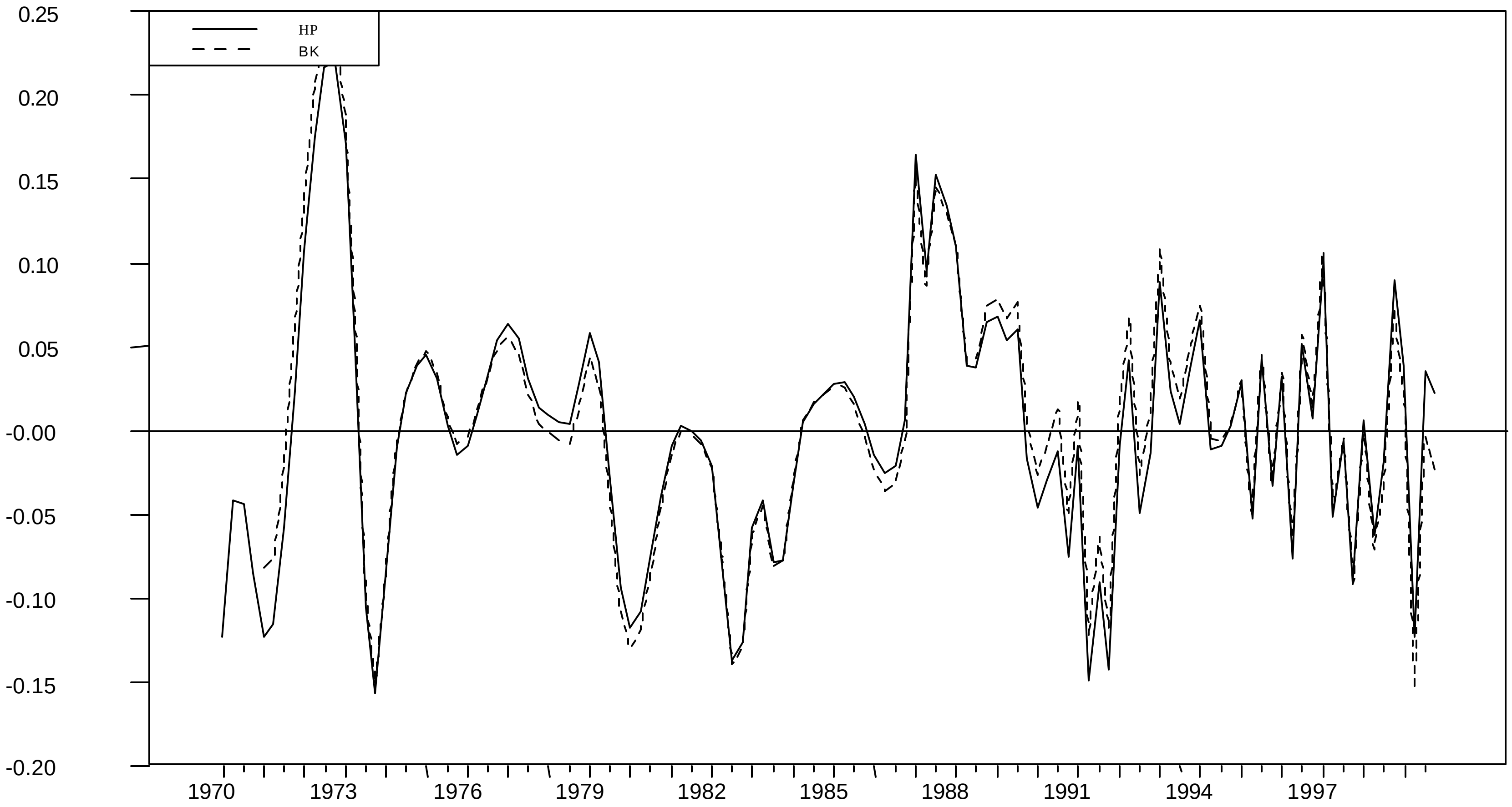
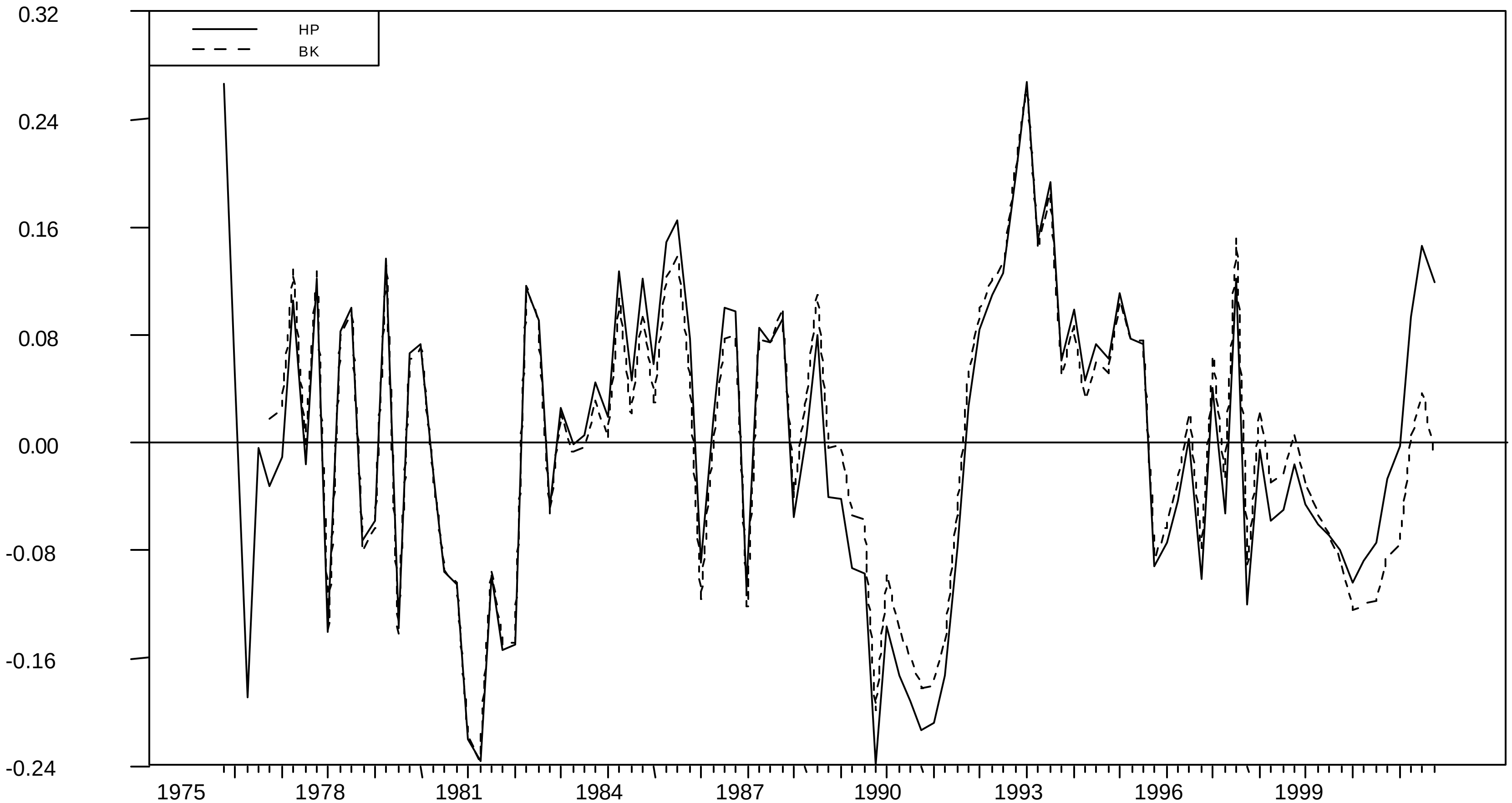


Chart 8: The Cyclical Component of Unemployment for Barbados: A Comparison of the Methods



From Table 4, seven cycles were discerned over the 1971Q1 to 1999Q2 period. From trough to trough, the cycles' lengths vary from 6 to 25 quarters, and from peak to peak they are between 7 and 24 quarters. At first glance, the movement of the cyclical component between 1973Q4 and 1982Q3 suggests the presence of a single cycle rather than the two identified. However, it is precisely this latter choice, which ensures compatibility with the limits set out by Baxter and King (1995), that is, between 6 and 32 quarters.

In the case of Barbados, using the BK and HP filters produce six troughs, of which the two largest appear between 1981Q2 and 1989Q4, and seven peaks, the most significant being, judging from its amplitude, that of 1993Q1 (see Table 5). Overall, over the twenty years starting from 1977, the amplitude of the unemployment cycle is greater in Barbados than in Trinidad and Tobago. On the other hand, with cycles measuring between 8 and 24 quarters using the trough-to-trough method and between 7 and 25 quarters peak to peak, the two countries do not display any significant differences with respect to the duration of unemployment cycles.

Looking at the statistical properties of the unemployment cycle (Table 6), the autocorrelations coefficients indicate that a shock to the system will persist longer in Barbados than in Trinidad and Tobago; the standard deviation suggests that volatility is higher in Trinidad and Tobago and the skewness and kurtosis are positive for Barbados but negative for Trinidad and Tobago.

Table 4: Peaks and Troughs in Trinidad and Tobago Unemployment Rate Cycle between 1972 and 2000 (% Change in GDP)

	Troughs			Peaks		
Date	**Amplitude**		**Time elapsed since last trough (in quarters)**	**Amplitude**		**Time elapsed since last peak (in quarters)**
	HP	**BK**		**HP**	**BK**	
1971:1	-4.64	-3.12				
1972:4				8.03	8.90	
1973:4	-5.71	-5.53	11			
1977:1				2.46	2.16	17
1980:1	-4.98	-5.48	25			
1981:2				0.13	0.01	17
1982:3	-5.75	-5.84	10			
1985:2				1.07	0.96	16
1986:2	-0.90	-1.27	15			
1987:1				5.61	5.26	7
1991:2	-4.96	-4.11	20			
1993:1				3.00	3.71	24
1996:2	-2.76	-2.60	20			
1997:1				3.71	3.90	16
1997:4	-3.35	-3.40	6			
1998:4				3.43	2.75	7
1999:2	-4.75	-5.90	6			

Table 5: Peaks and Troughs in Barbados Unemployment Rate Cycle between 1974 and 2001 (% Change in GDP)

	Troughs			Peaks		
Date	**Amplitude**		**Time elapsed since last trough (in quarters)**	**Amplitude**		**Time elapsed since last peak (in quarters)**
	HP	**BK**		**HP**	**BK**	
1977:2				3.87	5.78	
1978:1	-5.30	-5.35				
1979:2				5.30	5.12	7
1981:2	-9.26	-9.23	11			
1985:3				5.83	4.84	25
1987:1	-3.78	-4.26	23			
1987:4				3.23	3.48	9
1989:4	-8.37	-7.07	11			
1993:1				8.82	8.76	21
1995:4	-3.17	-2.97	24			
1997:3				4.61	5.75	18
1997:4	-4.57	-3.51	8			
2001:3				6.66	1.62	16

Table 6. Summary Statistics for the Cyclical Components of the Unemployment Rate for Barbados and Trinidad and Tobago

	Standard Deviation	Skewness	Kurtosis	Autocorrelations					
				Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6
Barbados									
HP	0.0742	0.3540	0.6447	0.6506	0.4422	0.1530	0.0269	-0.1941	-0.1442
BK	0.0754	0.5291	1.1662	0.6621	0.4547	0.1531	0.0328	-0.1642	-0.0925
Trinidad and Tobago									
HP	0.1115	-0.0861	-0.4924	0.5189	0.4345	0.3731	0.2756	0.0902	0.0718
BK	0.1017	-0.0832	-0.4921	0.5074	0.4732	0.3741	0.2984	0.0462	0.0506

5. Causality between the Cycles of Production and Unemployment Series

Having identified and described the production and unemployment cycles in the preceding sections, their causal relationship can now be examined. From a public-policy perspective, understanding this causal relationship is vital, no matter a country's level of development. This is because one of the central tenets of any government is to foster an enabling environment that promotes economic growth and employment generation. Therefore, public policy must be informed, wherever possible, by the benefits of realising a country's productive potential as the ultimate medium and long-term goal of ensuring the well being of its citizenry.

In this regard, it becomes necessary to measure the gap or "shortfall" between actual production (real GDP) and potential output - that is, the level of output that an economy can potentially sustain by optimal use of its capital and labour resources without exerting undue pressures in the goods and labour markets.

Since the beginning of the 1960s, economists have grappled with the problem of how best to determine an economy's productive potential. Several techniques have been proposed, some of which have been adopted by the Organisation of European Cooperation and Development (OECD), the IMF and the European Commission. For instance, the European Commission has been using the cyclical component derived from the HP filter as an estimator of productive potential, whilst the IMF and the OECD favour a structural econometric approach that employs a production function with substitutable factors, usually a Cobb-Douglas-type function.

Following the European Commission, the movement in the cyclical component of GDP is compared with that of unemployment to identify those periods that converge and diverge. Instead of undertaking a visual inspection, the correlation between these cyclical components are calculated with different time lags, that is, $\Delta(j), j \in 0, \pm 1, \pm 2, \ldots \pm 6$. From Table 7, most of the correlation coefficients are negative with absolute values less than 0.42. The negative value of $\Delta(0)$ seems to indicate that the unemployment rate leads the cycle by 2 periods for Barbados and 1 period for Trinidad and Tobago (the j that maximise $|\Delta(j)|$).

Table 7: Correlations between the Cyclical Components of Real GDP and Unemployment Rate of Barbados and Trinidad and Tobago

Lag	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Barbados													
HP	-0.34	-0.34	-0.46	-0.42	-0.47	-0.41	-0.42	-0.28	-0.22	-0.08	0.02	0.15	0.17
BK	-0.27	-0.26	-0.40	-0.36	-0.44	-0.38	-0.38	-0.26	-0.24	-0.03	0.07	0.14	0.14
Trinidad & Tobago													
HP	-0.28	-0.24	-0.26	-0.19	-0.22	-0.28	-0.29	-0.30	-0.24	-0.19	-0.11	-0.07	-0.02
BK	-0.23	-0.20	-0.24	-0.21	-0.26	-0.34	-0.36	-0.36	-0.30	-0.26	-0.18	-0.15	-0.10

Above it was shown that the correlations between the two cyclical components in Barbados and Trinidad and Tobago exist, although they were not very pronounced. Here, an attempt is made to formalise and quantify these correlations. This boils down to estimating the Okun's coefficient and testing Okun's Law. For many years, Okun's Law has been the main theoretical point of departure for analysing the relationship between economic activity and unemployment. Given that it stipulates the existence of an inverse relationship between employment and growth, Okun's Law formalises the idea that growth contributes to the re-absorbtion of unemployed persons into the labour force. Most of the empirical literature so far has tested this Law have employed data from major developed countries and a wide range of estimates of the Okun's coefficient has resulted, depending on whether: dynamic or static specifications were used, other variables such as capacity utilisation, hours per worker and labour force participation were included in the regressions, and a distinction made between demand and supply shocks (see Moosa, 1999 for more details).

Considering output (y), potential output (y*), the unemployment rate (u), and the structural rate of unemployment (u*), two alternatives specifications of the Okun's Law are used:

$$(u_t - u_t^*) = a \ (y_t - y_t^*) \tag{8}$$

$$\left(u_t - u_t^*\right) = \sum_{i=1}^{m} d_i \left(u_{t-i} - u_{t-i}^*\right) + \sum_{i=0}^{m} a_i \left(y_{t-i} - y_{t-i}^*\right) \tag{9}$$

Equation (8) represents the relationship between the cyclical components utilising only long-run contemporaneous effects, while Equation (9), which incorporates long-run effects also has short-run dynamics. The Okun's coefficient is directly a in Equation (8), whereas, in Equation (9) it is computed as a function of the coefficients a_i and d_i given by

$$w = \frac{\sum_{i=0}^{m} a_i}{1 - \sum_{i=1}^{m} d_i}.$$

The models (8) and (9) are estimated using a two-step procedure for both Barbados and Trinidad and Tobago. First, the cyclical components of y and u are tested for stationarity using the Dickey-Fuller and Philips-Perron tests. The results confirmed that the two series are stationary for both economies. Second, each equation is estimated by Ordinary Least Squares. With Equation (8), both for Barbados and Trinidad and Tobago, the a coefficient seems to be statistically significant and correctly signed. However, the regressions have very low R^2s (less than 20%). Moreover, the DW values indicate that the fitted equations have serial correlation, leading to the conclusion that these models may be misspecified. The estimation of Equation (9) with the introduction of short-run dynamics, has eliminated the serial correlation, but did not significantly improve the R^2 values. Hence, Okun's Law may not be very relevant in these two economies and may not be a correct measure of idle resources. This result validates the Todaro effect, which postulates that in small economies, when growth appears, it does not always bring employment. The regression results are not presented here, but are available on request.

6. Conclusion

This paper has presented some preliminary results of an examination of the business cycles of Barbados and Trinidad and Tobago within the RBC framework. The discussion has been guided by two main objectives. The first, which is essentially statistical and descriptive in nature, focused on establishing a chronology of the cyclical movements in the Barbadian and Trinidadian production and unemployment cycles, while highlighting and comparing their characteristics. The second is more analytical in nature and deals with the important conclusions to be drawn from the comparison of the cyclical components of these cycles.

The empirical results are interesting from various perspectives: (i) the application of the Hodrick-Prescott and Baxter-King filters to the quarterly real GDP and unemployment data revealed that both the Barbadian and the Trinidadian economies have experienced relatively moderate fluctuations during the course of the last three decades. The average amplitude of these fluctuations appears to be in line with those of other developing countries, but is much greater than those of many developed countries, which supports the hypothesis that small, open economies suffer the effects of economic shocks more intensely; (ii) the application of both of these filters to the data series may lead to divergent results. Nevertheless, they have the advantage of being able to provide estimates of the "output gap", thus shedding some light on the actual position of an economy within its structural fluctuations; (iii) the comparison of the structure of correlations between the cycles of the two variables for each country leads to the conclusion that unemployment is characterised by counter-cyclical effects; and (iv) they revealed that the phenomenon that economic growth contributes to the re-absorbtion of unemployed labour resources (that is, Okun’s Law) is not relevant for the economies of Barbados and Trinidad and Tobago.

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