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Abstract

Classical business cycles, following Burns and Mitchell (1946), can be defined as the sequential pattern of expansions and contractions in aggregate economic activity. Recently, Harding and Pagan (2002, 2006) have provided an econometric toolkit for the analysis of these cycles, and this has resulted in a recent surge in researchers using these methods to analyse developing country business cycles. However, the existing literature consists of diminutive samples and the majority fail to consider the statistical significance of the concordance statistics. To address this shortfall, this paper examines the business cycle characteristics and synchronicity for thirty-two developing countries. Furthermore, the US, the UK and Japan are included; this provides benchmarks upon which to compare the characteristics of the developing country cycles and also to examine the degree of synchronisation between developed and developing countries. Significantly, this research reveals that business cycles of developing countries are not, as previously believed, significantly shorter than those of the developed countries. However, the amplitude of both expansion and contraction phases tends to be greater in the developing countries. Furthermore a clear relationship between the timing of business cycle fluctuations and periods of significant regional crises, such as the Asian Financial Crisis, is exhibited. However, the more specific timing of the onset of these fluctuations appears to be determined by country-specific factors. Moreover, there are no clear patterns of concordance either within regions or between developed and developing country business cycles.

JEL Classification: C14, C41, E32, O50

Keywords: Classical business cycle; Turning points; Synchronisation; Concordance; Contagion; Developing economies.

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1 INTRODUCTION

The business cycle is commonly recognized as the periodic fluctuation of aggregate economic activity. More specifically, as highlighted by McDermott and Scott (1999) and Harding and Pagan (2005), there are two distinct methodologies for the description of business cycles, each lending itself to a completely different style of analysis. The first is the *classical* cycle, which can be defined as the sequential pattern of expansions and contractions in aggregate economic activity. This definition of the business cycle extends from the seminal work of Burns and Mitchell (1946), who state that:

“a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic” (p.3)

The second is the *growth* cycle which can be defined, following Lucas (1977) and Kydland and Prescott (1990), as the deviations of aggregate real output from trend. Analysis of this type of business cycle necessitates that the trend (or permanent component) be removed from the data, so that the cyclical component can be analysed. It is this cyclical component which is considered to be the *growth* cycle. This paper is concerned with characterising and analysing the classical business cycle of developing countries.

Central to the classical business cycle approach is the identification of a set of turning points, which separate the periods of expansion and contraction. This requires the application of a dating algorithm, such as the Bry and Boschan (1971) algorithm. The Bry-Boschan algorithm detects local maxima (peaks) and minima (troughs) for a single monthly (deseasonalized) reference series, typically real GDP, subject to certain censoring rules. Between a peak and a trough of economic activity an economy is in a contractionary phase (a recession), whilst between a trough and peak of activity an economy is in an expansionary phase (a boom). Harding and Pagan (2002) modify the algorithm to enable the dating of quarterly data.

Once the turning points have been identified, the characteristics of the business cycle, such as the duration and amplitude of the phases, can be analysed. Furthermore, since at any point in time the series can only be in one of two states, expansion or contraction, this provides a binary variable through which the cyclical patterns of two series can be compared. Harding and Pagan (2002) identify this feature of the data and propose a concordance statistic to measure the degree of synchronisation between two business cycles. This statistic is quantified by measuring the proportion of time that both series are in the same cyclical phase. A later paper, Harding and Pagan (2006), provides the methodology to test the statistical significance of the concordance statistic.

The influential work of Harding and Pagan (2002, 2006) on classical cycles has stimulated a burgeoning literature on developing country business cycles; notably Rand and Tarp (2002), Cashin (2004), Du Plessis (2006) and Calderon and Fuentes (2006). However, these typically examine only small groups of developing countries; Rand and Tarp (2002) analyse fifteen developing countries, Cashin (2004) examines six Caribbean

economies, Du Plessis (2006) looks at just seven economies and Calderon and Fuentes (2006) consider seven Latin American countries and seven Asian economies. This paper aims to extend the current literature, by examining the business cycle characteristics and synchronicity for a much larger set of thirty-two developing countries. Furthermore, the US, the UK and Japan are included; this provides benchmarks upon which to compare the characteristics of the developing country cycles and also to examine the degree of synchronisation between developed and developing countries.

Section two briefly reviews the findings of the developing country literature on classical business cycles. Section three details the methodologies employed in this analysis. Section four describes the data. Section five documents the characteristics of the developing country business cycles in terms of duration and amplitude. Section six examines the patterns of the timing of expansions and contractions in the developing country business cycles, and the degree of concordance between these countries. Finally, section seven concludes.

2 LITERATURE REVIEW

The significant papers of Harding and Pagan (2002, 2006) have provided a new toolkit for the analysis of business cycles, and this has renewed interest in analysing developing country cycles. The key characteristics that these recent papers have identified are outlined below. However, as this is a relatively new econometric toolkit, and due to problems with acquiring quarterly time-series data for many developing countries, the available literature remains sparse.

Rand and Tarp (2002) use the Bry-Boschan (1971) procedure to document the business cycle dates and durations for fifteen developing countries¹ for the period 1980 to 1998. They make the key finding that developing country business cycles are definitely shorter than those of the industrialised countries;

“the average duration of business cycles in developing countries (generally between 7.7 and 12.0 quarters) is clearly shorter than in the industrialised countries (between 24 and 32 quarters)” (Rand and Tarp, 2002, p.2076)

Examining the timings of peaks and troughs, they observe some synchronicity during major events, such as the second oil crisis in 1982, but that the majority of recessions and expansions are country specific. However, they do not consider any statistical measures of the degree of synchronisation. The paper then proceeds to examine the statistical properties of the *growth* cycle, which are not considered in this paper.

Cashin (2004) examines the key features of Caribbean business cycles² (1963:2003) using both *classical* and *growth* cycles and compares these to the cycles of Canada, Germany, the UK and the US. Concentrating on the *classical* cycles, Cashin (2004) reports the following key results. Firstly, Caribbean business cycles are asymmetric, with considerably longer periods of expansion than contraction. This asymmetry is

¹ Côte d'Ivoire, Malawi, Nigeria, South Africa and Zimbabwe, Chile Colombia, Mexico, Peru and Uruguay and India, and India, South Korea, Malaysia, Morocco and Pakistan.

² Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines.

corroborated in the analysis of the cycle amplitude, with the finding that average output decline during contractions is just 3%, whilst average output increase during expansions is 42%. Secondly, that there is evidence that several of the Caribbean countries co-move with Canada³ and the US⁴, suggesting that economic activity in North America has a positive effect on the Caribbean business cycles. This result extends from the correlation analysis of real output. Finally, the concordance statistic suggests that the degree of synchronisation amongst the Caribbean cycles and between the Caribbean cycles and the developed countries is very strong. However,

“the fact that most countries spend a very large proportion of the sample in an expansion phase has biased upward the measured value of concordance”

(Cashin, 2004, p.17).

After mean correcting the data and calculating the statistical significance of the concordance statistic, the only significant synchronisation is between the US and the UK. Thus, as Cashin (2004) stresses, it is vitally important to use hypothesis testing procedures to determine the significance of any observed concordance between business cycles.

Du Plessis (2006) examines the classical cycles, derived from quarterly real GDP data (1980 - 2004), for seven emerging market economies.⁵ From this, no clear pattern of business cycle duration is found; two of the seven countries exhibit longer cycles than those of the EMU Area, the US or Japan, three have business cycles of similar length to the developed countries, and two have shorter cycles. Although some evidence is found to suggest that the amplitude of both contractions and expansions is greater than that of the developed countries. Du Plessis (2006) does not examine the concordance amongst the emerging market economies, however the concordance between these countries and the EMU Area, the US and Japan is considered and the appropriate statistical significance levels calculated. The key finding from this analysis is that there is little evidence of co-movement between the business cycles of the emerging market economies and the developed economies.

Calderon and Fuentes (2006) identify the turning points in real GDP for fourteen emerging markets⁶ (of which seven are Latin American countries and seven are Asian countries). In characterising the cycles, they make the key findings; firstly, that the duration of contraction phases, but not expansion phases, across country groups are very similar, secondly that the Latin American countries experienced more contractions than the Asian countries, and finally that whilst output losses during contractions are larger in emerging market economies than in developed countries, output gains during expansions are greatest in the emerging market economies. They use concordance indices to examine the co-movement of the business cycles, finding high concordance amongst the Asian countries, but little evidence of concordance amongst the Latin American countries. Furthermore, they find that the Asian economies tend to move

³ Antigua and Barbuda, Grenada, and St. Kitts and Nevis.

⁴ Antigua and Barbuda, and Grenada.

⁵ Hong Kong, Israel, Korea, Mexico, Peru, the Philippines and South Africa.

⁶ Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela, and Hong Kong, Indonesia, Korea, Malaysia, Singapore, Taiwan and Thailand.

together with the US and Japan. However, the statistical significance of these concordance statistics is not calculated.

From reviewing these papers, a number of points are apparent. Firstly, the small samples employed in the analyses; yielding results that are not representative across a broad spectrum of developing countries. Secondly, the failure to calculate the statistical significance of the concordance statistic; only Cashin (2004) and Du Plessis (2006) calculate the statistical significance of their results. And finally, the lack of consistency amongst results, especially where the duration of the developing country cycles is concerned. This later point is particularly concerning, as cycle duration is critical to the correct identification of the *growth* cycle and hence the identification of business cycle stylised facts.⁷

Thus, this paper proceeds to conduct an empirical analysis to establish a much more comprehensive set of business cycle characteristics for developing country cycles. In particular, a key aim is to establish the duration of the developing country cycles. Furthermore, the pattern of synchronicity between developing country cycles and between the developing country cycles and the US, UK and Japan will be analysed, and the statistical significance of these relationships calculated.

3 METHODOLOGY

3.1. Identification of Turning Points: The Bry-Boschan (1971) Procedure

Following the seminal work of Burns and Mitchell (1946), the National Bureau of Economic Research (NBER) defines a country's business cycle as a sequence of expansionary and contractionary phases in a large set of series representing the economic activity of that country. These two phases are characterised by turning points (peaks and troughs) in the times series data; an expansionary phase is defined as trough-to-peak, whilst a contractionary phase is defined as peak-to-trough.

"The determination of cyclical turning points, which is usually performed on seasonally adjusted time series, is an essential element of the NBER's business cycle analysis" (Bry and Boschan, 1971, p.2)

However, as noted in Rand and Tarp (2002), the classical methodology of Burns and Mitchell and the NBER is complex and analytically demanding. The Bry-Boschan (BB) procedure (Bry and Boschan, 1971) simplifies this methodology, providing an algorithm to determine turning points in a single monthly series, such as real GDP.

⁷ The analysis of *growth* cycles requires that the time-series data are filtered to extract the stationary (cyclical) component. In business cycle research the most commonly applied detrending technique is the Hodrick Prescott (1997) filter. This filter requires the selection of a smoothing parameter, and this choice is determined by cycle duration. If developing country cycles are of a similar length to the developed country cycles, then the same smoothing parameter can be applied for all cycles. However, if business cycles in developing countries are considerably shorter than those of the developed countries, as suggested by Rand and Tarp (2002), then this will require the identification of a different smoothing parameter for the developing country cycles.

Table 1. Procedure for Programmed Determination of Turning Points

-
-
- I. Determination of extremes and substitution of values.
 - II. Determination of cycles in 12-month moving average (extremes replaced)
 - A. Identification of points higher (or lower) than 5 months on either side.
 - B. Enforcement of alternation of turns in selecting highest of multiple peaks (or lowest of multiple troughs).
 - III. Determination of corresponding turns in Spencer curve (extremes replaced)
 - A. Identification of highest (or lowest) value within ± 5 months of selected turn in 12-month moving average.
 - B. Enforcement of minimum cycle duration of 15 months by eliminating lower peaks and higher troughs of shorter cycles.
 - IV. Determination of corresponding turns in short-term moving averages of 3 to 6 months, depending on MCD (months of cyclical dominance).
 - A. Identification of highest (or lowest) value within ± 5 months of selected turn in Spencer curve.
 - V. Determination of turning points in unsmoothed series.
 - A. Identification of highest (or lowest) value within ± 4 months, or MCD term, whichever is larger, of selected turn in short-term moving average.
 - B. Elimination of turns within 6 months of beginning and end of series.
 - C. Elimination of peaks (or troughs) at both ends of series which are lower (or higher) than values closer to the end.
 - D. Elimination of cycles whose duration is less than 15 months.
 - E. Elimination of phases whose duration is less than 5 months.
 - VI. Statement of final turning points.
-
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Bry and Boschan (1971, p.21; Table 1)

The BB procedure detects local maxima (peaks) and minima (troughs), for a single time series, subject to certain censoring rules.⁸ It first identifies major cyclical swings, then delineates in the neighbourhoods of their maxima and minima, and finally narrows the search for turning points to specific calendar dates. Details of the full procedure, including the censoring rules, are provided in Table 1.⁹

3.2. Measuring Cycle Characteristics: Duration, Amplitude

The Bry-Boschan (1971) algorithm locates peaks and troughs in the data; between which the series is either in a contractionary phase (peak-to-trough) or an expansionary phase (trough-to-peak). Following Harding and Pagan (2001), a binary variable S_t is defined which takes on the value 1 when the series is an expansionary phase and zero otherwise. Using this binary variable and the original series y_t it is possible to produce measures of various cycle characteristics, as defined in Harding and Pagan (2001).

The first measures the average duration of the expansion and contraction phases of the cycle. The average duration of an expansion is defined by Harding and Pagan (2001) to be:

$$\hat{D} = \frac{\sum_{t=1}^T S_t}{\sum_{t=1}^{T-1} (1 - S_{t+1}) S_t} \quad (1)$$

⁸ For details of the censoring rules, see Table 2.1.

⁹ This procedure was programmed into MATLAB by Rand and Tarp (2002) and is used here with their kind permission; full details of the MATLAB code are provided in Appendix A.

Where, $\sum_{t=1}^T S_t$ measures the total duration of expansions for the series and $\sum_{t=1}^{T-1} (1 - S_{t+1}) S_t$ measures the number of peaks in the series.

The second measure, measures the average amplitude of expansion and contraction phases. The average amplitude of expansion phases is defined by Harding and Pagan (2001) to be:

$$\hat{A} = \frac{\sum_{t=1}^T S_t \Delta y_t}{\sum_{t=1}^{T-1} (1 - S_{t+1}) S_t} \quad (2)$$

Where, $\sum_{t=1}^T S_t \Delta y_t$ measures the total change in economic activity during expansions.

Harding and Pagan (2001) note that the possibility of incomplete phases at the beginning and end of the series may cause difficulties with the use of these measures. Thus, in this analysis these measures are only considered for completed phases.

3.3. Measuring Synchronization: The Concordance Statistic

Following Harding and Pagan (2002) the degree of synchronisation between two *classical* business cycles can be carried out through the application of the concordance statistic. This statistic measures the proportion of time that two cycles are in the same phase (expansion or contraction). Once again a binary variable S_t is defined which takes on the value one when the series is an expansionary phase and zero otherwise.

Let there be two time series, x_t and y_t and define the binary variables S_{x_t} and S_{y_t} . When series x_t is in an expansionary phase, $S_{x_t} = 1$, otherwise $S_{x_t} = 0$, and similarly when series y_t is in an expansionary phase, $S_{y_t} = 1$, otherwise $S_{y_t} = 0$. Then, following Harding and Pagan (2002), the degree of concordance is defined as:

$$\hat{I} = T^{-1} \left[\sum_{t=1}^T S_{x_t} S_{y_t} + \sum_{t=1}^T (1 - S_{x_t}) (1 - S_{y_t}) \right] \quad (3)$$

Where, T is the number of observations.

The concordance index \hat{I} measures the proportion of time that the two series, x_t and y_t , are in the same phase, with an \hat{I} of unity implying that the two cycles are in the same phase 100 percent of the time.

However, a measure of whether the degree of synchronisation estimated by \hat{I} is statistically significant is also required. The solution to this problem was provided by Harding and Pagan (2006), who suggest using the correlation between S_{x_t} and S_{y_t} to test for no concordance; where the null hypothesis of no concordance between series x_t and y_t corresponds to a correlation coefficient ρ_s of zero. Further, they state that, under the assumption of mean independence, an estimate of the correlation coefficient $\hat{\rho}_s$ can be obtained from the regression:

$$\frac{S_{y_t}}{\hat{\sigma}_{S_x} \hat{\sigma}_{S_y}} = \alpha + \rho_s \frac{S_{x_t}}{\hat{\sigma}_{S_x} \hat{\sigma}_{S_y}} + u_t \quad (4)$$

Where, $\hat{\sigma}_{S_x}$ and $\hat{\sigma}_{S_y}$ are the estimated standard deviations of S_{x_t} and S_{y_t} , respectively.

The t-statistic associated with $\hat{\rho}_s$ in the above regression can be used to evaluate the statistical significance of the null hypothesis of no concordance between the two

series. However, as noted by Harding and Pagan (2006), in order to get the correct t-statistic for $\hat{\rho}_s$ it is necessary to use heteroscedastic and autocorrelation consistent (HAC) standard errors. To this purpose, GMM estimation with a HAC covariance matrix is used; the Bartlett kernel and the Newey and West fixed bandwidth are selected.¹⁰

4 DATA DESCRIPTION AND COUNTRY INFORMATION

There are thirty-two developing countries included in this sample, of which there are five African countries (Côte d'Ivoire, Malawi, Nigeria, Senegal and South Africa), four North African and Middle Eastern countries (Israel, Jordan, Morocco and Tunisia), nine Latin American countries (Argentina, Barbados, Brazil, Chile, Colombia, Mexico, Peru, Trinidad and Tobago, and Uruguay), eight Asian countries (Bangladesh, Hong Kong, India, South Korea, Malaysia, Pakistan, the Philippines and Turkey) and six Central and Eastern European countries (Hungary, Lithuania, Macedonia, Romania, the Slovak Republic and Slovenia). In addition, three developed countries, the United Kingdom, the United States and Japan, are included as benchmarks upon which to compare the results for the developing countries.

The developing countries in the sample were selected primarily on the basis of data availability, and to ensure the data set is both geographically representative and representative of developing countries at different stages of economic development. Table 2 provides summary information about the countries included in this analysis, including: GNI per capita and World Bank income classifications, Human Development Index (HDI) scores and UN development classifications, and average GDP and GDP per capita growth rates.

Reliable real GDP data, which is usually used as a measure of the aggregate business cycle, is not available for a large number of developing countries. This is especially prevalent where quarterly data, which is necessary for the analysis of business cycle turning points, is concerned. Thus, following the suggestion of Agénor *et al.* (2000), indexes of industrial production are used as a suitable proxy for the aggregate business cycle:

“The manufacturing sector accounts for a significant fraction of total GDP...In addition, because output in the industrial sector roughly corresponds to output in the traded goods sector (excluding primary commodities) and is most closely related to what are traditionally thought of as business cycle shocks, either exogenous or policy determined, we argue that this variable is a reasonable proxy for measuring the aggregate cycle” (Agénor *et al.*, 2000, p.255)

In this sample of developing countries, the proportion of total GDP which is accounted for by the manufacturing sector varies from an average of 19.6% in Barbados to 46.16% in Trinidad and Tobago, with a sample average of 32.2%.¹¹ Figure 1 shows the composition of GDP for the sample countries, whilst Table 3 provides a summary of GDP composition for the regional groupings and for the income groupings.

¹⁰ This procedure is performed using the statistical package STATA.

¹¹ These are based on averages for the period 1980 – 2005 for the series Industry, value added (% of GDP) from the World Bank World Development Indicators.

Table 2. Summary Information for Sample Countries

	GNI per Capita			HDI			Average Growth Rate (%)	
	1985	1995	2005	1985	1995	2005	GDP	GDP per Capita
United States	17,070	27,910	43,570	0.909	0.939	0.955	2.97	1.89
United Kingdom	8,100	19,430	38,320	0.870	0.929	0.947	2.36	2.09
Japan	10,900	40,350	38,950	0.902	0.931	0.956	2.38	1.98
Africa								
Côte d'Ivoire	610	660	820	...	0.456	0.480	0.76	-2.54
Malawi	160	160	220	0.379	0.453	0.476	2.51	-0.53
Nigeria	370	220	620	...	0.450	0.499	2.84	0.14
Senegal	...	...	800	...	0.399	0.460	2.88	0.17
South Africa	2,420	3,740	4,810	0.680	...	0.678	2.19	0.15
North Africa								
Israel	6,000	14,090	20,060	0.853	0.883	0.929	4.19	1.88
Jordan	1,990	1,560	2,490	0.638	0.656	0.764	4.68	1.03
Morocco	600	1,120	2,000	0.499	0.562	0.640	3.64	1.76
Tunisia	1,160	1,820	2,870	0.605	0.654	0.758	4.37	2.46
Latin America								
Argentina	2,660	7,360	4,460	0.797	0.824	0.855	1.59	0.57
Barbados	4,450	7,000	9,330	...	...	0.890	1.27	1.21
Brazil	1,570	3,740	3,970	0.694	0.734	0.805	2.46	0.75
Chile	1,420	4,340	5,930	0.762	0.822	0.872	5.11	3.55
Colombia	1,210	2,200	2,880	0.698	0.757	0.795	3.11	1.40
Mexico	2,190	3,810	8,080	0.768	0.794	0.844	2.78	1.04
Peru	960	1,990	2,660	0.703	0.744	0.791	2.13	0.36
Trinidad and Tobago	5,880	3,850	10,710	0.791	0.797	0.825	2.25	1.52
Uruguay	1,510	5,540	4,820	0.783	0.817	0.855	1.51	1.19
Asia								
Bangladesh	200	310	440	0.351	0.415	0.527	4.29	2.16
Hong Kong	6,110	23,490	28,150	0.830	0.886	0.939	5.27	4.04
India	300	380	740	0.453	0.511	0.596	5.71	3.89
Korea, South	2,340	10,770	16,900	0.760	0.837	0.927	6.66	5.53
Malaysia	1,950	4,030	5,200	0.689	0.767	0.821	6.28	3.69
Pakistan	370	490	720	0.423	0.469	0.555	5.20	2.65
Philippines	520	1,020	1,260	0.651	0.713	0.744	2.86	0.59
Turkey	1,280	2,710	6,230	0.674	0.730	0.796	4.11	2.46
East Europe								
Hungary	1,880	4,110	10,260	0.813	0.816	0.874	1.53	1.85
Lithuania	...	2,070	7,280	...	0.791	0.862	0.20	1.25
Macedonia	...	1,710	2,810	...	0.782	0.810	-0.35	-0.47
Romania	...	1,470	3,920	...	0.780	0.824	0.72	0.96
Slovak Republic	...	3,310	8,190	...	0.827	0.867	1.65	1.78
Slovenia	...	8,500	18,060	...	0.861	0.918	2.36	2.49

	HDI Classification		GNI per Capita Classification		
			1985	1995	2005
Low Human Development	HDI < 0.500	Low Income	≤ 480	≤ 765	≤ 875
Medium Human Development	0.500 < HDI < 0.799	Lower Middle Income	481 - 1,940	766 - 3,035	876 - 3,465
High Human Development	0.800 < HDI < 0.899	Upper Middle Income	1,941 - 6,000	3,036 - 9,385	3,466 - 10,725
Very High Human Development	HDI > 0.900	High Income	> 6,000	> 9,385	> 10,725

The average GDP and GDP per capita growth rates are calculated from GDP growth (annual %) and GDP per capita growth (annual %), respectively, from the World Bank World Development Indicators (WDI) for the period 1980 to 2005. GNI per capita is GNI per capita (Atlas method, current US\$) from the World Bank WDI, and the income classifications are taken from the World Bank GNI per capita Operational Guidelines and Analytical Classifications. Human Development Index (HDI) rankings and classifications are from the UN Human Development Reports. Following the UN classification, all countries with an HDI below 0.900 are classified as developing economies, whilst all countries with an HDI above 0.900 are classified as developed economies.

Figure 1. Composition of GDP

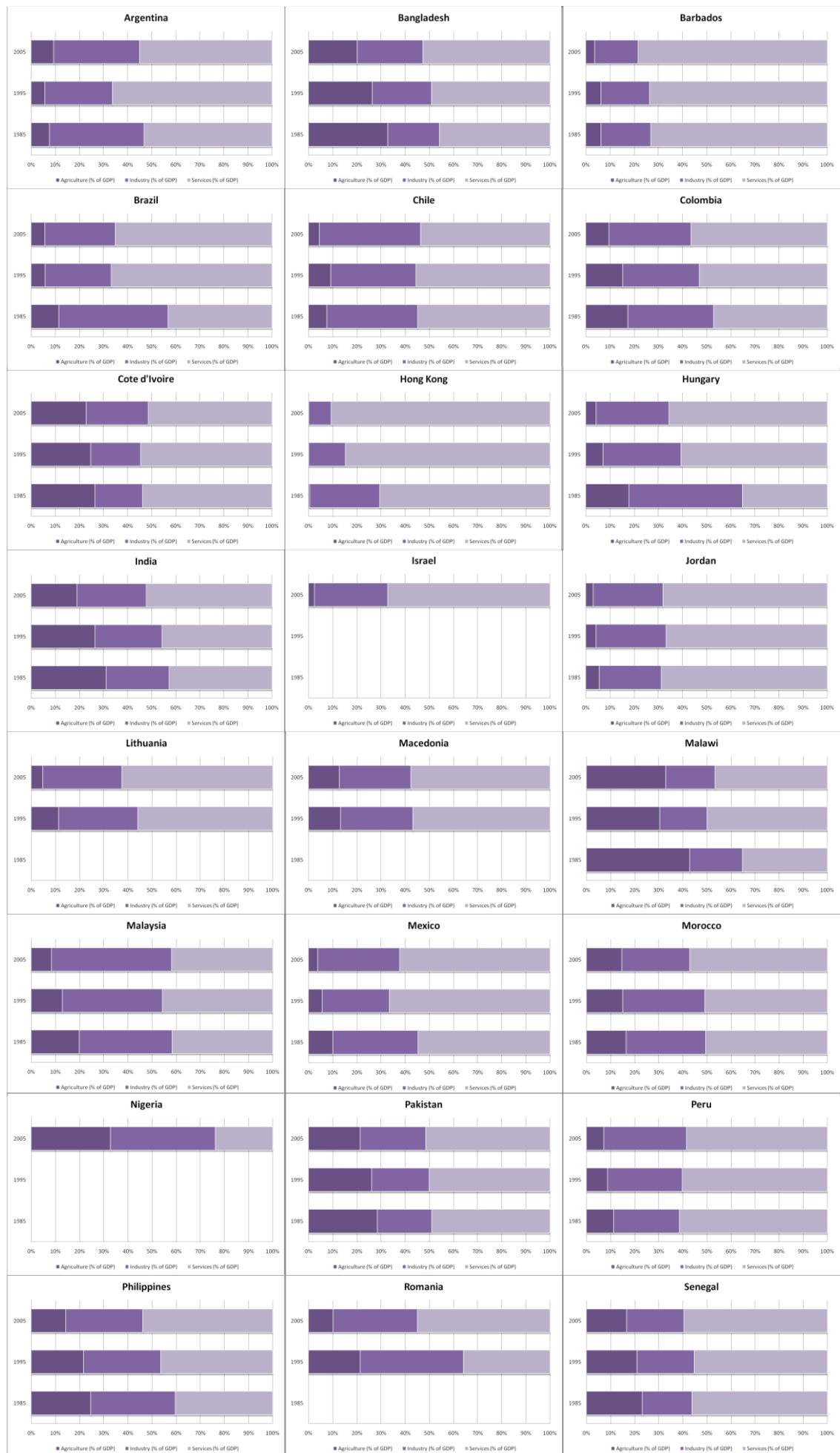


Figure 1. Composition of GDP (continued...)



Table 3. GDP Composition by Region and Income Grouping

	Agriculture (% of GDP)	Industry (% of GDP)	Services (% of GDP)
Africa	26.10	28.43	45.48
	<i>14.81</i>	<i>8.67</i>	<i>15.19</i>
North Africa	11.78	29.48	58.73
	<i>6.01</i>	<i>2.25</i>	<i>8.25</i>
Latin America	7.97	33.27	58.73
	<i>3.48</i>	<i>7.19</i>	<i>6.89</i>
Asia	17.67	30.09	52.24
	<i>9.95</i>	<i>7.96</i>	<i>11.34</i>
Eastern Europe	10.27	37.96	51.77
	<i>4.87</i>	<i>4.16</i>	<i>6.09</i>
Low Income	29.72	25.48	44.80
	<i>7.34</i>	<i>5.83</i>	<i>11.49</i>
Lower-Middle Income	12.90	31.04	56.06
	<i>5.49</i>	<i>2.49</i>	<i>7.67</i>
Upper-Middle Income	8.62	35.22	56.15
	<i>4.80</i>	<i>7.15</i>	<i>9.15</i>
High Income	1.99	32.20	65.81
	<i>0.42</i>	<i>4.64</i>	<i>4.87</i>

Figures are averages for the period 1980 to 2005. Numbers in italic are standard deviations. Agriculture is agriculture, value added (% of GDP), industry is industry, value added (% of GDP) and services is services, value added (% of GDP) from the World Bank, World Development Indicators.

From Table 3 it is clear that the greatest component of GDP, for all countries, is services. Unfortunately, quarterly services data is not available for the majority of countries, and thus cannot be examined in this paper. However, consistent with the above assertion of Agénor *et al.* (2000), manufacturing production does make up a significant proportion of GDP, exceeding agriculture for all but the poorest economies. Furthermore, manufacturing production makes up the largest proportion of merchandise exports for most of the developing countries. The only exceptions are the African countries, for whom, on average, food and fuel exports exceed manufacturing exports (as a percentage of merchandise exports). Figure 2 details the composition of merchandise exports for the developing countries, whilst Table 4 summarises the composition of exports for the regional and income groupings.

Thus, this analysis follows the suggestion of Agénor *et al.* (2000) and employs indexes of industrial production as a proxy of the aggregate business cycle. The data comes from the International Monetary Fund (IMF) International Financial Statistics (IFS) database and either manufacturing production (IMF IFS series 66EY) or industrial production (IMF IFS series 66) is employed. The sample period varies depending on the availability of quarterly data for each country; however there is good data coverage for the period from 1980 to 2004 across countries.¹²

Further to this, given the importance of agricultural production for the poorest economies, the analysis is also extended such that the duration of industrial production and agricultural production cycles can be compared. Unfortunately, quarterly agricultural data is only available for a small sub-set of the developing countries included in this study; namely, Brazil, Chile, Colombia, Hungary, India, Lithuania, Malaysia, Mexico, Philippines, South Africa, South Korea, Slovak Republic, and Turkey.

¹² This provides 24 years of data, or 96 quarterly observations. Given the fact that business cycles are estimated to be between 7.7 and 12 quarters for developing economies and between 24 and 32 quarters for developed economies (Rand and Tarp, 2002), this ensures that the time series should include at least three full business cycles for each economy. Obvious exceptions to this are the Eastern European countries, Lithuania, Macedonia, Slovak Republic and Slovenia for which the time series is reduced to the period 1992 to 2005; however this still provides coverage for at least one complete cycle.

Figure 2 . Composition of Manufacturing Exports

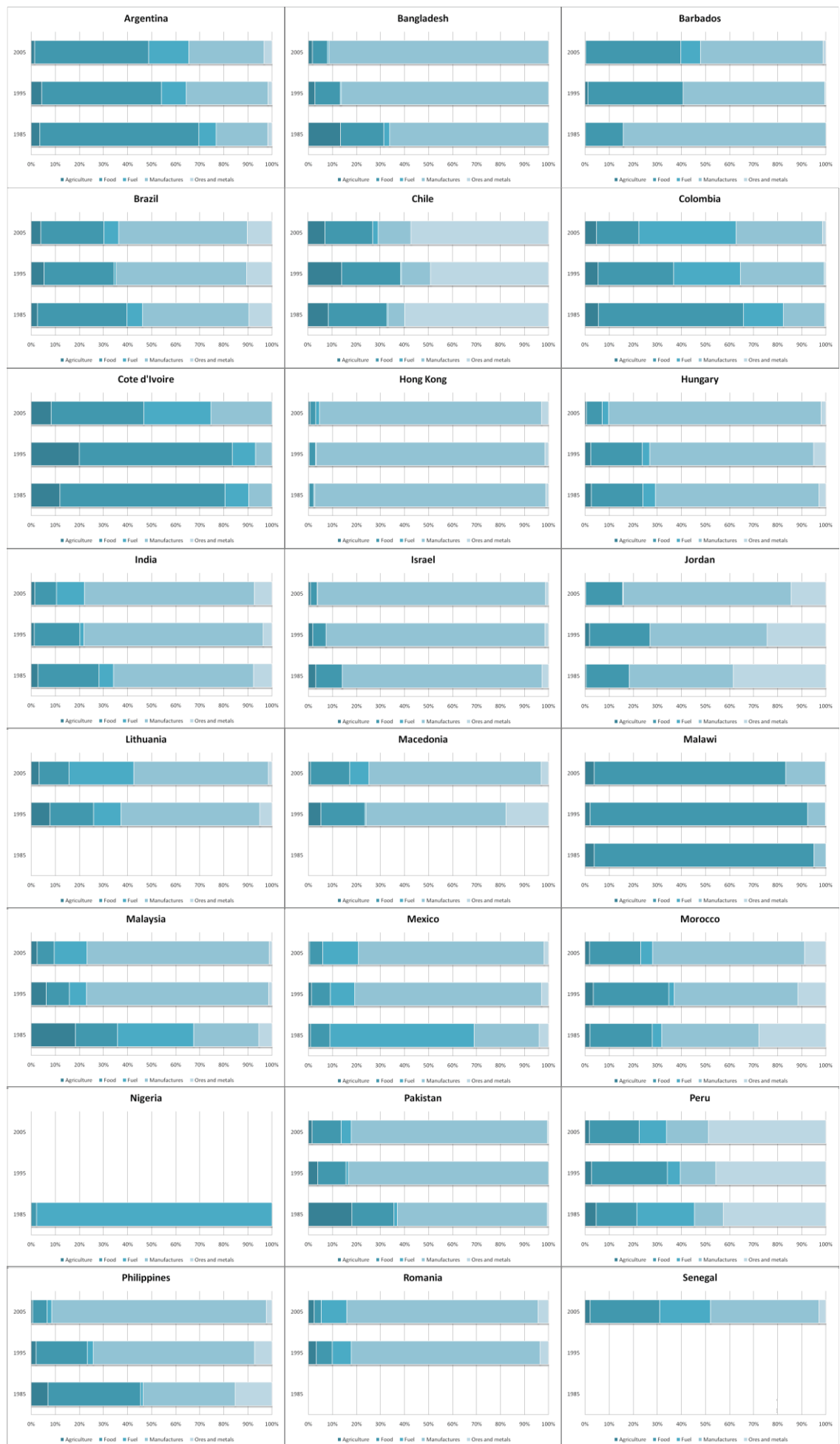


Figure 2 . Composition of Manufacturing Exports (continued...)



Table 4. Composition of Merchandise Exports by Region and Income Grouping

	Agriculture (% of exports)	Food (% of exports)	Fuel (% of exports)	Manufactures (% of exports)	Ores and metals (% of exports)
Africa	4.52	38.17	27.29	20.34	4.33
	<i>4.72</i>	<i>36.06</i>	<i>39.25</i>	<i>17.60</i>	<i>5.86</i>
North Africa	1.53	15.13	6.10	64.36	12.63
	<i>1.03</i>	<i>8.34</i>	<i>9.91</i>	<i>17.19</i>	<i>13.47</i>
Latin America	4.80	29.37	16.95	35.23	12.05
	<i>5.34</i>	<i>16.28</i>	<i>21.02</i>	<i>17.03</i>	<i>19.40</i>
Asia	4.60	12.73	3.80	73.21	2.56
	<i>4.14</i>	<i>7.24</i>	<i>4.99</i>	<i>13.91</i>	<i>2.30</i>
East Europe	2.77	10.38	6.76	75.17	4.30
	<i>1.24</i>	<i>6.67</i>	<i>6.10</i>	<i>10.76</i>	<i>2.44</i>
Lower Income	5.22	32.37	19.42	40.36	2.11
	<i>4.29</i>	<i>30.97</i>	<i>34.65</i>	<i>33.52</i>	<i>3.60</i>
Lower-Middle Income	1.96	18.55	6.45	51.49	17.38
	<i>1.07</i>	<i>5.44</i>	<i>7.89</i>	<i>18.81</i>	<i>14.71</i>
Upper-Middle Income	4.05	18.00	11.03	59.03	5.67
	<i>4.35</i>	<i>15.94</i>	<i>15.78</i>	<i>24.67</i>	<i>11.41</i>
High Income	1.69	6.31	4.56	82.01	2.19
	<i>1.65</i>	<i>5.40</i>	<i>5.15</i>	<i>11.24</i>	<i>0.94</i>

Figures are averages for the period 1980 to 2005. Numbers in italic are standard deviations.

Agriculture is agricultural raw materials exports (% of merchandise exports), food is food exports (% of merchandise exports), fuel is fuel exports (% of merchandise exports), manufactures is manufactures exports (% of merchandise exports) and ores and metals is ores and metals exports (% of merchandise exports) from the World Bank, World Development Indicators.

5 CYCLE CHARACTERISTICS

5.1. Duration

Tables 5(a) and 5(b) summarises the average duration (in quarters) of the business cycle by regional and income grouping, respectively. In looking at this, it is particularly interesting to examine the finding of Rand and Tarp (2002), namely that business cycles in the developing countries are significantly shorter than those of the developed countries.

Table 5(a). Average Business Cycle Duration (By Region)

Region	Average Duration (in quarters)		
	Expansion	Contraction	Cycle
US, UK and Japan	15.9	4.7	20.1
Africa	8.3 [§]	5.9	14.4[§]
North Africa	20.0	5.1	22.2
Latin America	12.0	5.1	14.2[§]
Asia	26.4	4.7	30.4
Eastern Europe	14.4	7.7	22.5

Table 5(b). Average Business Cycle Duration (By Income)

Region	Average Duration (in quarters)		
	Expansion	Contraction	Cycle
High Income	14.8	4.8	19.7
Upper Middle Income	16.6	6.0	20.4
Lower Middle Income	16.6	4.9	19.4
Low Income	16.0	5.2	21.3

Significant differences from the developed country benchmarks are denoted by § ($p < 0.05$) and ¶ ($p < 0.01$). Average duration of the cycle is the average of completed cycles, measured both from peak to peak and from trough to trough.

The results in Tables 5(a) and 5(b) indicate that there is no clear significant difference between the developing country and developed country business cycles. The African and Latin American regions display significantly shorter cycles than the rest of the sample. However, the North African, Eastern European and developed countries have very similar length cycles, whilst the Asian countries have substantially longer cycles than the rest of the sample. Furthermore, comparison between income groups reveals no significant differences in cycle length.¹³

However, there is a rather simple explanation for this. Besides the relatively small sample, Rand and Tarp (2002) have compared their results based on industrial production for the developing countries with the standard results for developed country cycles, but these developed country cycles will have been calculated using real GDP not real industrial production! When both developing and industrialised country business cycles are compared using the same variable, real industrial (or manufacturing)

¹³ However, the average duration for the low income group is skewed upwards by the extremely long duration observed in the Indian data; see Table 2.6 for country specific duration statistics.

production in this case, it is clear that developed country business cycles are not significantly longer than their developing country counterparts. Du Pleissis (2006) similarly finds that the developing country business cycles are not significantly shorter than those of the developed countries, when using real GDP to compare seven emerging market economies with the USA, EMU and Japan.

Finally, from Tables 5(a) and 5(b) it is interesting to note that the average length of contractionary phases is fairly equal between all the regional groups, indicating that the slow growth in developing countries is not the result of excessively long recessions.

Departing from the regional and income grouping analysis, it is also prudent to examine business cycle duration for each of the countries in the sample. Consequently, Table 6 provides the details of the business cycles, and also the data period, for each country within a region.

Examination of Table 6 reveals some noticeable outliers within each regional group; within the Asian group, there are two outliers namely Bangladesh and Hong Kong, which have significantly shorter average length business cycles than the other Asian countries. Furthermore, Hong Kong, Lithuania and Macedonia are the only countries within this sample which have an average contraction length in excess of the average expansion length, implying that they are experiencing negative economic growth in terms of industrial production. This may be explained by a move away from industrial production towards services and other components of GDP in these economies. In particular, Hong Kong has undergone massive structural transformation with a significant movement from manufacturing to services over the sampling period;

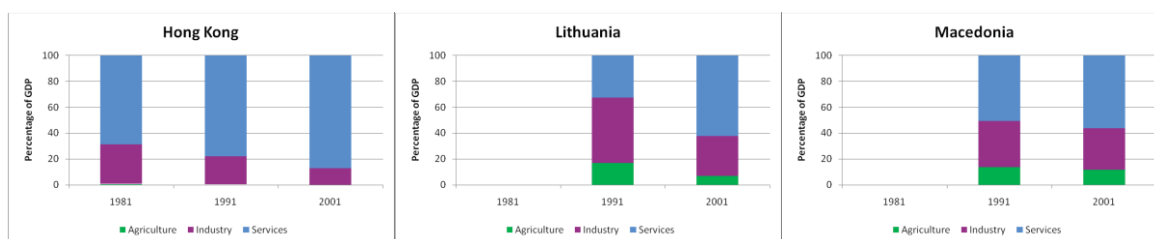
“During the 1960s and 1970s, an abundant supply of inexpensive labour supported the rapid growth of Hong Kong’s manufacturing sector. By the late 1970s, however, Hong Kong’s competitiveness in manufacturing had started to erode as land and labour costs rose. When China began its policy of economic reform in 1978, manufacturing started to relocate from Hong Kong to southern China, where labour and facility costs were much lower...The extensive transfer of manufacturing operations and the sustained rapid increase in China’s export activity boosted the development of supporting service industries in Hong Kong, not notably in trade and financial services.” (Husain, 1997, pp.3–4)

Similarly, following the collapse of the Soviet Union and Yugoslavia, respectively, in 1991, both Lithuania and Macedonia have undergone significant structural transformations, with a movement away from industrial production towards services. Analysing the Lithuanian economy, Budrauskaitė *et al.* (2002) find that, with all the markets and sources of raw material predominantly located in the Former Soviet Union, *“the output structure was designed to meet the demand of the Union, making its industries uncompetitive in the world market”* (p.74), thus necessitating the subsequent structural transformation of the economy. Examining the structure of Lithuanian GDP in 1991 and 2001, it is possible to see that the share of industrial production declined dramatically from 51% to 31%, whilst services increased from 33% to 62%. Figure 3 exhibits the changing composition of GDP for Hong Kong, Lithuania and Macedonia for the years 1981, 1991 and 2001.

Table 6. Average Business Cycle Duration (By Country)

Region	Country	Period	Average Duration (in quarters)			
			Expansion Phases	Contraction Phases	Business Cycle	
					P-P	T-T
	US	1960:1 – 2005:4	16.7	4.4	18.8	21.1
	UK	1960:1 – 2005:3	15.1	4.9	21.3	21.5
	Japan	1960:1 – 2005:4	12.7	5.1	18.0	17.7
Africa	Côte d'Ivoire	1968:1 – 2003:4	6.1	5.6	11.7	12.5
	Malawi	1970:1 – 2004:2	6.7	5.2	12.1	12.0
	Nigeria	1970:1 – 2003:4	8.3	5.9	14.1	15.2
	Senegal	1985:4 – 2003:4	8.0	4.3	12.3	12.3
	South Africa	1965:3 – 2005:1	12.3	8.4	21.1	21.1
North Africa	Israel	1960:3 – 2004:4	21.9	6.5	27.9	28.4
	Jordan	1972:1 – 2004:4	13.2	5.6	11.7	12.5
	Morocco	1965:3 – 2003:3	24.8	4.3	19.7	29.1
	Tunisia	1967:1 – 2005:1	20.3	4.0	17.5	30.7
Latin America	Argentina	1994:1 – 2004:1	6.0	6.0	10.5	12.5
	Barbados	1973:1 – 2004:4	10.7	5.9	15.7	16.5
	Brazil	1991:1 – 2005:1	31.1	3.2	11.2	11.1
	Chile	1965:3 – 2005:1	11.6	5.2	16.9	17.2
	Colombia	1980:1 – 2005:1	10.3	4.8	12.8	15.1
	Mexico	1965:3 – 2005:1	14.8	6.0	19.6	21.5
	Peru	1979:1 – 2005:1	8.8	6.0	15.5	13.6
	Trinidad & Tobago	1978:1 – 2003:4	8.3	3.9	12.0	12.0
	Uruguay	1979:1 – 2002:3	6.3	5.3	11.9	10.7
Asia	Bangladesh	1973:1 – 2004:3	7.7	3.3	11.2	11.1
	Hong Kong	1982:1 – 2004:4	6.1	7.7	12.4	13.9
	India	1960:3 – 2004:4	52.0	7.7	55.1	56.0
	Korea, South	1960:3 – 2005:1	49.1	3.3	43.1	52.4
	Malaysia	1970:1 – 2004:4	32.0	2.8	35.1	35.1
	Pakistan	1970:3 – 2004:3	23.5	4.4	28.5	34.0
	Philippines	1981:1 – 2005:1	28.0	5.1	32.5	32.0
	Turkey	1980:1 – 2005:1	13.1	3.5	16.7	16.7
Eastern Europe	Hungary	1979:1 – 2005:1	32.0	18.0	...	50.0
	Lithuania	1993:1 – 2005:1	4.5	6.5	11.1	15.1
	Macedonia	1993:1 – 2004:4	4.3	4.5	8.8	9.7
	Romania	1980:1 – 2005:1	15.3	9.1	30.0	24.4
	Slovak Republic	1993:1 – 2005:1	18.0	4.0	...	22.0
	Slovenia	1992:1 – 2005:1	12.4	4.0	19.1	12.0

Figure 3. The Changing Composition of GDP in Hong Kong, Lithuania and Macedonia



Of the Latin American countries, Brazil appears to be performing much better than the rest, with an average expansion phase of 31.1 quarters compared with the regional average of just 14.2 quarters. Finally, South Africa appears to be fairing slightly better than the other African countries, with an above group average business cycle length and expansion phase length, whilst Jordan appears to be fairing worse than average within the North African countries, with the shortest expansion phases and business cycle duration.

Given the focus on developing economies, an interesting comparison lies in the duration of industrial production and agricultural production cycles; Tables 7(a) and 7(b) compare the cycles in industrial production and agricultural output. As you would expect, these tables indicate that business cycles in agricultural output are on average much shorter than those in industrial output. There is also less regional difference in agricultural output cycle length.

From analysing both the agricultural output cycles¹⁴ and the industrial output cycles an interesting example emerges, which is that of India. In the case of India, there is a substantial difference between the agricultural cycle and the result for the industrial output cycle. Of all the countries in the sample, India has both the longest average industrial output cycle, at nearly 56 quarters, and the shortest average agricultural cycle, at just less than 5 quarters.

Historically, India has relied very heavily on agricultural output and agriculture continues to account for 19.2% of GDP.¹⁵ Thus, given the extremely short agricultural cycles, this reliance on agriculture may go some way to explaining India's low GDP per capita ranking; India was ranked at just 152nd (out of 232 countries) in 2004 and continues to be classified as a low income economy by the World Bank.¹⁶ However, the structure of the Indian economy has undergone a significant shift during the last 50 years; for the period 1960 to 2004, agriculture, as a percentage of GDP, has declined by 55.1% whilst industrial production has increased by 44.1% and services have increased by 39.9%. Thus, the impact that the extremely short agricultural cycles have on the aggregate business cycle is declining. Mohanty, Singh and Jain (2003) find that prior to 1990 supply shocks, in the form of monsoon failures and oil price shocks, were the key sources of cyclical fluctuations in Indian output, but that since 1990 these fluctuations are increasingly influenced by the economy's internal dynamics. Furthermore, Mall (1999) finds that non-agricultural GDP is the key reference series for tracking business

¹⁴ It has not been possible to similarly analyse business cycles in services, due to a lack of suitable data for the developing countries.

¹⁵ Based on 2004 data for agriculture, value added (% of GDP) from the World Bank, World Development Indicators.

¹⁶ See Table 2

cycles in India. This further indicates the declining importance of agricultural output as a driving force of the Indian economy.

Table 7(a). Average Duration of Agricultural and Industrial Business Cycles (By Country)

Region	Country	Period	Average Duration (in quarters)			
			Expansion Phases	Contraction Phases	Business Cycle	
					P-P	T-T
US		I	12.5	3.3	14.1	15.8
		A	5.9	3.8	9.6	9.7
UK		I	11.3	3.7	16.0	16.1
		A	7.0	3.4	10.4	11.0
Africa						
South Africa		I	9.2	6.3	15.8	15.8
		A	4.5	6.5	7.1	12.8
Latin America						
Brazil		I	23.3	2.4	8.4	8.3
		A	8.3	3.8	12.0	6.0
Chile		I	8.7	3.9	12.7	12.9
		A	5.6	6.8	9.0	5.3
Colombia		I	7.7	3.6	9.6	11.3
		A	3.0	4.5	8.0	6.8
Mexico		I	11.1	4.5	14.7	16.1
		A	6.7	3.0	9.7	9.8
Asia						
India		I	39.0	5.8	41.3	42.0
		A	3.0	1.8	4.8	4.9
Korea, South		I	36.8	2.5	32.3	39.3
		A	6.4	3.2	8.6	9.6
Malaysia		I	24.0	2.1	26.3	26.3
		A	6.4	3.4	9.8	7.5
Philippines		I	21.0	3.8	24.4	24.0
		A	12.0	3.6	15.8	16.3
Turkey		I	9.8	2.6	12.5	12.5
		A	6.3	3.2	7.7	9.8
Eastern Europe						
Hungary		I	24.0	13.5	...	37.5
		A	4.1	3.0	7.5	7.1
Lithuania		I	3.4	4.9	8.3	11.3
		A	4.1	4.3	7.8	8.8
Slovak Republic		I	13.5	3.0	...	16.5
		A	4.1	5.0	9.0	9.8

I = cycle in industrial (or manufacturing) production, A = cycle in agricultural production.

Table 7(b). Average Duration of Agricultural and Industrial Business Cycles (By Region)

Region	Industrial Output			Agricultural Output		
	Average Duration (in quarters)			Average Duration (in quarters)		
	Expansion	Contraction	Cycle	Expansion	Contraction	Cycle
US, UK and Japan	15.9	4.7	20.1	8.5	4.8	13.6
Africa	8.3	5.9	14.4	6.0	8.7	13.2
North Africa	20.0	5.1	22.2	...	...	...
Latin America	12.0	5.1	14.2	7.9	6.0	11.1
Asia	26.4	4.7	30.4	9.1	4.0	12.5
Eastern Europe	14.4	7.7	22.5	5.5	5.5	11.1

For notes, see Table 5.

5.2. Amplitude

The amplitude of the expansion and contraction phases of the business cycles is a measure of the extent that economic activity changes during the phase. Tables 8(a) and 8(b) summarise the average amplitude of expansion and contraction phases by regional and income groupings, whilst Table 9 details average amplitude for each country.

Tables 8(a) and 8(b) clearly demonstrate that the amplitude of both contraction and expansion phases is significantly greater in the developing countries than in the US, UK or Japan. In particular, the Asian countries, on average, experience 42% growth in output during expansion phases. When this is combined with the extremely long average expansion phases and short contraction phases, it helps explain the remarkably high growth rates that these countries have experienced in recent years. Conversely, the East European and African countries in the sample experience the largest decreases in economic activity during contraction phases, which may help explain their relatively poor economic growth performance.

Table 8(a). Average Amplitude of Expansions and Contractions (By Region)

Region	Average Duration (In quarters)			Average Amplitude (%)		Average GDP Growth Rate (%)
	Expansion	Contraction	Cycle	Expansion	Contraction	
US, UK and Japan	15.9	4.7	20.1	11.9	-2.7	2.6
Africa	8.3 [§]	5.9	14.4 [§]	16.8	-15.1 [§]	2.2
North Africa	20.0	5.1	22.2	24.1	-6.1	2.5
Latin America	12.0	5.1	14.2 [§]	17.8	-13.9 [§]	2.5
Asia	26.4	4.7	30.4	42.0	-13.2	5.0
Eastern Europe	14.4	7.7	22.5	17.7	-16.1	1.0

Table 8(b). Average Amplitude of Expansions and Contractions (By Income)

Region	Average Duration (In quarters)			Average Amplitude (%)		Average GDP Growth Rate (%)
	Expansion	Contraction	Cycle	Expansion	Contraction	
High Income	14.8	4.8	19.7	11.9	-2.7	2.6
Upper Middle Income	16.6	6.0	20.4	24.7	-12.9 [§]	2.9
Lower Middle Income	16.6	4.9	19.4	28.7	-16.5	2.9
Low Income	16.0	5.2	21.3	16.7	-11.8 [§]	3.5

Significant differences from the developed country benchmarks are denoted by § ($p < 0.05$) and ¶ ($p < 0.01$). The average GDP Growth Rate is calculated from GDP growth (annual %), taken from the World Bank World Development Indicators, for the period 1980 to 2004.

Referring now to Table 9, which details average amplitude for each country, it is possible to see that Senegal experiences, on average, a 23.6% reduction in output during contractions and just a 19.4% increase during expansions; this suggests that, in industrial production at least, over the sample period Senegal has experienced negative economic growth. Furthermore, Hungary, Lithuania and Macedonia all experience greater decreases in output during contractions than increases during expansions and this is matched in the cases of Lithuania and Macedonia with extremely low GDP growth rates.

On the other hand South Korea experienced, on average, a massive 106.6% increase in industrial production during expansion phases and just a decrease of 7% during contractions. This suggests South Korea will have experienced dramatic growth in industrial production over the sample period. In fact, South Korea also has the highest average annual GDP growth rate of all the countries in this sample, at 6.7%.

Table 9. Average Amplitude of Expansion and Contraction Phases (By Country)

Region	Country	Period	Average Amplitude (%)		Average GDP Growth Rate (%)
			Expansion Phases	Contraction Phases	
	US	1960:1 – 2005:4	6.4	-1.9	3.0
	UK	1960:1 – 2005:3	18.5	-0.1	2.4
	Japan	1960:1 – 2005:4	10.9	-6.1	2.4
Africa	Côte d'Ivoire	1968:1 – 2003:4	14.0	-8.9	0.8
	Malawi	1970:1 – 2004:2	19.6	-16.2	2.5
	Nigeria	1970:1 – 2003:4	19.0	-16.3	2.8
	Senegal	1985:4 – 2003:4	19.4	-23.6	2.9
	South Africa	1965:3 – 2005:1	12.3	-10.5	2.2
North Africa	Israel	1960:3 – 2004:4	25.3	-5.9	4.2
	Jordan	1972:1 – 2004:4	26.3	-11.4	4.7
	Morocco	1965:3 – 2003:3	14.9	-4.8	3.6
	Tunisia	1967:1 – 2005:1	29.7	-2.1	4.4
Latin America	Argentina	1994:1 – 2004:1	12.3	-30.2	1.6
	Barbados	1973:1 – 2004:4	11.7	-11.0	1.3
	Brazil	1991:1 – 2005:1	12.2	-7.7	2.5
	Chile	1965:3 – 2005:1	18.4	-7.1	5.1
	Colombia	1980:1 – 2005:1	17.1	-8.2	3.1
	Mexico	1965:3 – 2005:1	18.1	-9.2	2.8
	Peru	1979:1 – 2005:1	23.3	-21.7	2.1
	Trinidad & Tobago	1978:1 – 2003:4	35.1	-17.3	2.2
	Uruguay	1979:1 – 2002:3	12.0	-12.4	1.5
Asia	Bangladesh	1973:1 – 2004:3	16.3	-7.6	4.3
	Hong Kong	1982:1 – 2004:4	14.4	-9.8	5.3
	India	1960:3 – 2004:4	...	-3.8	5.7
	Korea, South	1960:3 – 2005:1	106.6	-7.8	6.7
	Malaysia	1970:1 – 2004:4	56.9	-10.3	6.3
	Pakistan	1970:3 – 2004:3	11.9	-6.6	5.2
	Philippines	1981:1 – 2005:1	69.1	-49.6	2.9
	Turkey	1980:1 – 2005:1	18.8	-10.0	4.1
Eastern Europe	Hungary	1979:1 – 2005:1	17.8	-28.4	1.5
	Lithuania	1993:1 – 2005:1	38.5	-40.5	0.2
	Macedonia	1993:1 – 2004:4	8.6	-9.2	-0.4
	Romania	1980:1 – 2005:1	4.6	-13.4	0.7
	Slovak Republic	1993:1 – 2005:1	27.1	-3.0	1.7
	Slovenia	1992:1 – 2005:1	9.5	-2.4	2.4

The average GDP growth rate is calculated from GDP growth (annual %), taken from the World Bank World Development Indicators, for the period 1980 to 2004.

6 SYNCHRONISATION OF BUSINESS CYCLES

6.1. Timing of Peaks and Troughs

The coincidence of peaks and troughs of the developing country business cycles are examined to determine whether they are independent. Or, indeed whether they are related to those of the other developing countries or those of the developed countries. Given that a peak indicates that an economy is about to enter a recession and that a trough indicates that an economy is about to enter an expansion phase, it is possible to examine the timing of peaks and troughs to see whether there is any relationship between countries' business cycles.

Table 10 details the timings of business cycle peaks and troughs for each country, as calculated using the Bry-Boschan (1971) dating algorithm. When a country's business cycle reaches a peak this is recorded with a P in the table, whilst when a country's business cycle reaches a trough this is recorded with a T in the table. Between a peak (P) and a trough (T) the business cycle is in a contractionary phase. Between a trough (T) and a peak (P) the business cycles is in an expansionary phase.

Table 10 reveals that there is clearly some relationship between countries in terms of the timing of peak and troughs. Most of these are either within regional groups and/or in line with periods of significant regional crises, such as the Asian financial crisis. However, as noted by Rand and Tarp (2002), the more specific timing of the start of a recession appears to be determined by country-specific factors.

Examination of the regional groups provides evidence that the timing of peaks and troughs, and thus the business cycles, are fairly synchronised amongst the Latin American countries and amongst the Asian countries. However, there appears to be much less cohesion between the business cycles of the African countries. Kose *et al.* (2003) similarly find that African cycles tend to be driven by country specific shocks, and thus show little synchronisation.

The synchronous timing of peaks and troughs during periods of economic crisis corresponds to the notion of contagion; whereby, knowledge of a crisis elsewhere increases the probability of a crisis at home (Eichengreen *et al.*, 1996), thus yielding synchronous cycles. There are numerous explanations for the contagious nature of crises.¹⁷

Firstly, the crisis may result from a common shock, such as an oil price shock, which similarly affects several countries. Masson (1998) defines the transmission of such shocks to be *monsoonal effects*, rather than contagion. Secondly, the crisis may be transmitted through trade and financial linkages; this is the fundamentals-based contagion mechanism (Calvo and Reinhart, 1996). As with the common shock mechanism, Masson (1998) does not classify this type of transmission as contagion, but rather defines it as a *spillover effect*. Finally, the crisis may be transmitted through changes in expectations, and is predominantly associated with financial market information frictions (Pesenti and Tille, 2000). This final transmission mechanism provides an avenue for the transmission of crises to countries which are apparently

¹⁷ For a detailed discussion of crisis transmission mechanisms see Pesenti and Tille (2000).

unrelated, and thus is consistent with the definition of *pure* (Masson, 1998) or *true* (Calvo and Reinhart, 1996) contagion.

In light of this, several crisis episodes are considered in turn to examine the timing of recessions across the regions and the possible causes of any observed contagion. Firstly, the international oil crisis, which occurred during the period 1979 to 1980, and the subsequent recession in the industrialised countries during the early 1980s. Table 10 reveals that the UK, US, India, South Korea and Israel all begin a contractionary phase during 1979:1 (1979:2 for the UK), closely followed by the Latin American countries in 1980. This also corresponds with the Latin American debt crisis of the 1980s. A further lag sees the majority of the African countries experiencing a recession beginning in 1981.

The synchronisation of the business cycles at this point in time would appear to be a monsoonal effect, since the driving force is a common oil price shock. However, the developing countries appear to respond to the crisis with a lag. This could be explained by the developing countries responding to the depression in the industrialised countries rather than to the shock directly. Frankel and Roubini (2001), for example, intuitively explain that the recession amongst industrialised countries during the early 1980s depressed prices and volumes for exports from developing countries; thereby causing the developing countries themselves to enter a contractionary period and precipitating the subsequent international debt crisis. Thus, this is a fundamentals-based contagion. Following this period of recession, there is a coincidence of peaks in Latin America and Asia (plus South Africa and Jordan) during 1984 suggesting a further contractionary phase in these regions.

Secondly, the Mexican peso crisis, which began in Mexico in 1994. This crisis resulted in significant speculative pressure on the currencies of several Latin American and Asian economies (Calvo and Reinhart, 1996).¹⁸ However, this crisis appears to have had a limited impact on the business cycles of the Latin American and Asian economies; Table 10 reveals that only Argentina, Brazil and Hong Kong follow Mexico into a recession. Walker (1998) suggests a number of explanations for the relatively limited extent of the Mexican crisis, in comparison to the Asian financial crisis; the Asian financial crisis occurred in 1997 and will be discussed subsequently. Firstly, potential liquidity problems were reduced as a result of Mexico's relationship with the US; "*commitment to NAFTA made the United States effectively a lender of last resort to Mexico*" (Walker, 1998, p.10). Secondly, the low ratio of domestic credit to GDP amongst the Latin American countries provided room for the central banks to raise interest rates without generating a outbreak of defaults. Thirdly, the firm stance and decisive action taken by the Latin American countries, particularly in Mexico and Argentina, acted to enhanced market credibility. Finally, Walker (1998) suggests that capital controls in Brazil and Chile may have slowed speculative flows; although no evidence is provided to support this postulation.

¹⁸ Notably, Brazil and Argentina in Latin America, and Hong Kong, Malaysia, the Philippines and Thailand in Asia.

Table 10. Coincidence of Peaks (P) and Troughs (T)

	1979				1980				1981				1982				1983				1984				1985				1986				1987				1988				1989				1990				1991				1992			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
UK			P																	P																																				
US	P						T									T																																								
Japan					P		T																																																	
Argentina																																																								
Barbados					P											T																																								
Brazil																																																								
Colombia																T																																								
Chile																																																								
Mexico																																																								
Peru																																																								
Trinidad																																																								
Uruguay																																																								
Bangladesh																																																								
Hong Kong																																																								
India	P																																																							
Korea, South	P																																																							
Malaysia																																																								
Pakistan																																																								
Philippines																																																								
Turkey																																																								
Côte d'Ivoire																																																								
Malawi																																																								
Nigeria																																																								
Senegal																																																								
South Africa																																																								
Israel	P																																																							
Jordan	T																																																							
Morocco																																																								
Tunisia																																																								

Finally, the Asian financial crisis, which began in July 1997 in Thailand and subsequently spilled over to Latin American countries. Looking at Table 10 there is a clear pattern of peaks starting in the second quarter of 1997, with the majority of countries in the sample entering recession by the end of 1998. There does not appear to be a lag between the start of recessions in the Asian countries and the start in the Latin American countries. However the Asian economies do appear to recover more quickly with Japan, South Korea, Malaysia and the Philippines all beginning expansionary phases during the later part of 1998. Interestingly, the UK and the US do not appear to be affected by the Asian financial crisis.

Kaminsky and Reinhart (2000) find that capital flows played a central role in the Asian financial crisis, and thus suggest that the financial interdependence of countries was particularly important in propagating the crisis. Where countries rely on common lenders, the behaviour of these banks can act to both exacerbate the original crisis and spread the crisis to the other borrowers. For example, following the intuition of Pesenti and Tille (2000), assume there are three countries A, B and C, and a foreign bank D. Country A experiences a currency crisis which affects the ability of domestic residents to repay loans to D. In light of this, D will try to rebuild its capital by recalling some of the loans made to borrowers in countries B and C. These borrowers now face a credit crunch, and the crisis is spread. However, the impact of this crisis on countries B and C relies on the dependence on bank D; the greater the initial dependence on bank D, the greater the impact of the crisis. Thus, providing an explanation as to why the contagion affects some countries more than others. In the case of the Asian financial crisis, Japanese banks were important lenders to the Asian economies. In particular, on the eve of the crisis, 54% of Thai liabilities were held by Japanese banks (Kaminsky and Reinhart, 2000). Thus, assuming that the Japanese banks tried to recoup their losses by recalling capital from the other Asian economies, this provides a promising explanation. In particular, if the Japanese banks held few US and UK liabilities, then this helps to explain why the US and UK avoided the onset of a contractionary phase.

Another possible explanation for both the pattern of contagion during the Asian Financial Crisis and the reason for US and UK escaping unscathed, arises from the work of Corsetti *et al.* (1999). They examine the mechanism of international transmission of exchange rate shocks and demonstrate how trade linkages may result in the contagion of such shocks. Following the intuition of Corsetti *et al.* (1999), let there be three countries A, B and C, of which A and B are trading partners; if country A devalues its currency then country B becomes less competitive and consequently will also devalue. Thus, the shock is passed on to country B and the movements of the two business cycles will be synchronised. On the other hand, if country B is large relative to A but both A and B are small relative to C, then Corsetti *et al.* (1999) demonstrate that country B is better off not matching the devaluation. Consequently, in this case there will be no contagion effect and the business cycles of countries A and B will not be synchronised. The US and the UK are important trading partners for many of the countries affected by the Asian Financial Crisis¹⁹. However the US and UK are also relatively large compared to these countries. If C is considered to be the rest of the world then, certainly in the case of the

¹⁹ See Table 11.

UK, the second case holds, whereby the US and UK are better off not matching the devaluations of the countries affected by the crisis; thus there is no contagion to the US or UK.

However, whilst these interpretations successfully explain why the US and UK were unaffected by the Asian financial crisis, they are not satisfactory in explaining the pattern of contagion amongst the developing countries. Given the number of countries involved and their geographic spread, it is highly unlikely that the contagion is entirely the result of similarities in macroeconomic fundamentals. Thus, another explanation is required.

Calvo (1999), Calvo and Mendoza (2000) and Mendoza and Smith (2002), amongst others, relate the observed pattern of contagion to asymmetrical information in financial markets. One of the key assumptions underlying these papers is that country-specific information is costly. For example, Calvo (1999) and Calvo and Mendoza (2000) assume that gathering country specific information involves large fixed costs. Thus, two types of investors will exist: the informed and the uninformed. Informed investors are much more likely to leverage their portfolios, and as such these investors will be subject to marginal calls.²⁰ Meanwhile, uninformed investors simply mimic the behaviour of the informed investors. Consequently, if the uninformed investor observes that the informed investor is selling securities they will follow suit, resulting in a generalised outflow of capital from the economy. However, the decision of the informed individual reflects information relevant to them, such as a marginal call, and not necessarily information about the condition of the economy. Thus, the reaction of the uninformed may cause a crisis which has nothing to do with the fundamentals of the economy. Furthermore, since gathering information is costly, there will be a tendency for investors to consider groups of countries within regions to be the same. As such, country-specific information will be applied to the entire group. Thus, the reaction of the uninformed provides a mechanism by which the whole region can catch the contagion, with no change in macroeconomic fundamentals. However, whilst this explains the pattern of contagion within regional groups, it fails to explain the contagion between the Asian economies and the Latin American economies.

Thus, this approach is enhanced by Kodres and Pritsker (2002), who place emphasis on contagion through *cross-market rebalancing*, to explain the observed patterns of contagion during the Asian financial crisis. Cross-market rebalancing occurs as a result of investors, who are active in more than one market, optimally adjusting their portfolios. Assume that there is a negative shock in one country; Thailand, in the case of the Asian financial crisis. In response to this shock, investors will optimally adjust their portfolios in other markets. In this way, contagion is generated as the shock is transmitted to the other markets, without necessitating that the countries are linked through macroeconomic fundamentals. Thus, this helps to explain the contagion between the weakly linked Asian and Latin American economies. This effect is further magnified in markets with information asymmetries. Therefore, given that information asymmetries are greatest amongst the developing countries, this can also explain why the developing

²⁰ Marginal calls occur when, for example, securities purchased with borrowed money decrease in value and thus the investor will be required to increase the margin deposited or close out the position.

economies suffered the worst of the contagion during the Asian financial crisis, whilst the US and UK escaped relatively unscathed.

6.2. Concordance

The previous analysis has highlighted the contagion of crises amongst countries, and the consequent synchronisation of business cycle peaks and troughs. However, this analysis is now extended to examine the overall degree of synchronisation between the business cycles. This is performed through the use of the Harding and Pagan (2002) concordance statistic, which measures the degree of synchronisation between the business cycles of two countries. Theoretically, it is expected that the developing country business cycles will be synchronised with the business cycles of their major trading partners and investors, as discussed in Aruoba (2001). For example, a significant positive concordance statistic is to be expected between a developing country's business cycle and the cycles of the key recipients of its exports. If the purchasing country goes into a recession, their import demand will decrease and hence the developing country's exports will decline stimulating the onset of a recession. Table 11 details the key trading partners for each of the countries included in this analysis. Thus, from the details provided in Table 11, a strong degree of synchronisation between the majority of developing country cycles and the US business cycle should be expected. Although, this is not the case for the Eastern European region; on average, trade with the US comprises just 3% of exports and 2.6% of imports.²¹

However, Caldéron *et al.* (2007) find that whilst trade intensity is an important factor in increasing business cycle synchronisation amongst the industrialised countries, this is of significantly less importance in the synchronisation between developed and developing country cycles and between developing country cycles. This is also consistent with previous research which suggests that whilst there is a strong degree of synchronisation between industrialised country business cycles,²² the degree of synchronisation for developing country cycles is rather more varied. For example, Kose *et al.* (2003) suggest that developing country business cycle fluctuations tend to be country specific, particularly in Asia and Africa, and consequently exhibit little synchronisation with other business cycles.

Table 12 details concordance statistics and pair-wise correlations for all the countries; the concordance statistic is above the diagonal and the correlation coefficient below. As anticipated, there is strong significant concordance between the US and UK business cycles. However, neither of these cycles are significantly concordant with the Japanese business cycle. The results for the synchronisation of the developing country business cycles are also somewhat varied, as expected.

²¹ Averages calculated from annual volume of trade data for exports and imports (cif) from the IMF Direction of Trade Statistics (DOTS) for the period 1985 to 2005.

²² For example, Backus, Kehoe and Kydland (1995) find strong positive correlations between US output and nine other industrialised country business cycles.

Table 11. Key Trading Partners for Sample Countries

		Exports – Key Trading Partners			Imports – Key Trading Partners		
		1	2	3	1	2	3
United States	1985	Canada	Japan	Mexico	Japan	Canada	Germany
	1995	Canada	Japan	Mexico	Canada	Japan	Mexico
	2005	Canada	Mexico	Japan	Canada	China	Mexico
United Kingdom	1985	US	Germany	France	Germany	US	France
	1995	US	Germany	France	Germany	US	France
	2005	US	Germany	France	Germany	US	France
Japan	1985	US	China	Korea, South	US	Saudi Arabia	Indonesia
	1995	US	Korea, South	Hong Kong	US	China	Korea, South
	2005	US	China	Korea, South	China	US	Saudi Arabia
Africa							
Côte d'Ivoire	1985	Netherlands	France	US	France	Nigeria	US
	1995	France	Netherlands	Italy	France	Nigeria	US
	2005	France	US	Netherlands	France	Nigeria	Singapore
Malawi	1985	UK	US	Germany	South Africa	UK	Japan
	1995	Germany	US	France	South Africa	UK	Germany
	2005	US	South Africa	Egypt	South Africa	Zambia	Mozambique
Nigeria	1985	US	Italy	France	UK	US	Germany
	1995	US	Spain	France	UK	US	Germany
	2005	US	Spain	Brazil	China	US	UK
Senegal	1985	France	Mali	Côte d'Ivoire	France	US	Côte d'Ivoire
	1995	India	France	Italy	France	Nigeria	US
	2005	Mali	India	France	France	Nigeria	Brazil
South Africa	1985	...	...	...	...	...	...
	1995	...	...	...	...	...	...
	2005	Japan	UK	US	Germany	China	US
North Africa							
Israel	1985	US	UK	Germany	US	Germany	UK
	1995	US	Japan	UK	US	Germany	UK
	2005	US	Belgium	Hong Kong	US	Belgium	Germany
Jordan	1985	Iraq	India	Saudi Arabia	Saudi Arabia	US	Iraq
	1995	Iraq	India	Saudi Arabia	Iraq	US	Germany
	2005	US	Iraq	India	Saudi Arabia	China	Germany
Tunisia	1985	France	Italy	Germany	France	Italy	Germany
	1995	France	Italy	Germany	France	Italy	Germany
	2005	France	Italy	Germany	France	Italy	Germany
Latin America							
Argentina	1985	US	Netherlands	Brazil	US	Brazil	Germany
	1995	Brazil	US	Chile	Brazil	US	Italy
	2005	Brazil	US	Chile	Brazil	US	China
Barbados	1985	US	Guyana	UK	US	T&T	UK
	1995	UK	US	T&T	US	T&T	UK
	2005	US	T&T	UK	US	T&T	UK
Brazil	1985	US	Netherlands	Japan	US	Iraq	Nigeria
	1995	US	Argentina	Japan	US	Argentina	Germany
	2005	US	Argentina	China	US	Argentina	Germany
Chile	1985	US	Japan	Germany	US	Venezuela	Brazil
	1995	Japan	US	UK	US	Argentina	Brazil
	2005	US	Japan	China	Argentina	US	Brazil
Colombia	1985	US	Germany	Netherlands	US	Japan	Germany
	1995	US	Venezuela	Germany	US	Venezuela	Japan
	2005	US	Venezuela	Ecuador	US	Mexico	China
Mexico	1985	US	Japan	Spain	US	Japan	Germany
	1995	US	Canada	Japan	US	Japan	Germany
	2005	US	Canada	Japan	US	China	Japan
Peru	1985	US	Japan	Germany	US	Argentina	Japan
	1995	US	Japan	UK	US	Colombia	Chile
	2005	US	China	Chile	US	China	Brazil
Trinidad & Tobago	1985	US	Italy	UK	US	Japan	UK
	1995	US	Jamaica	France	US	UK	Venezuela
	2005	US	Jamaica	Barbados	US	Brazil	Japan
Uruguay	1985	Brazil	US	Germany	Brazil	Iran	Argentina
	1995	Brazil	Argentina	US	Brazil	Argentina	US
	2005	US	Brazil	Argentina	Brazil	Argentina	Russia

Table 11. Key Trading Partners for Sample Countries (continued...)

		Exports – Key Trading Partners			Imports – Key Trading Partners		
		1	2	3	1	2	3
Asia							
Bangladesh	1985	US	Iran	Japan	Japan	US	Singapore
	1995	US	UK	Germany	India	China	Japan
	2005	US	Germany	UK	India	China	Kuwait
Hong Kong	1985	US	China	<i>Japan</i>	China	Japan	US
	1995	China	US	Japan	China	Japan	US
	2005	China	US	<i>Japan</i>	China	Japan	Singapore
India	1985	US	Japan	UK	US	Japan	Germany
	1995	US	Japan	UK	US	Germany	Japan
	2005	US	UAE	China	China	US	Switzerland
Korea, South	1985	US	Japan	Hong Kong	Japan	US	<i>Malaysia</i>
	1995	US	Japan	Hong Kong	Japan	US	China
	2005	China	US	Japan	Japan	China	US
Malaysia	1985	Japan	Singapore	US	Japan	Singapore	US
	1995	US	Singapore	Japan	Japan	US	Singapore
	2005	US	Singapore	Japan	Japan	US	Singapore
Pakistan	1985	Japan	US	Saudi Arabia	US	Japan	Saudi Arabia
	1995	US	Hong Kong	Germany	Japan	US	Malaysia
	2005	US	UAE	Afghanistan	Saudi Arabia	UAE	China
Philippines	1985	US	Japan	Singapore	US	Japan	Malaysia
	1995	US	Japan	Singapore	Japan	US	Saudi Arabia
	2005	US	Japan	Singapore	US	Japan	Singapore
Turkey	1985	Germany	Iran	Iraq	Germany	Iran	Iraq
	1995	Germany	US	Italy	Germany	US	Italy
	2005	Germany	UK	Italy	Germany	Russia	Italy
Eastern Europe							
Hungary	1985	Germany	Austria	Poland	Germany	Austria	Poland
	1995	Germany	Austria	Italy	Germany	Russia	Austria
	2005	Germany	Italy	Austria	Germany	Russia	China
Lithuania	1985	...	...	...	...	...	...
	1995	Russia	Germany	Belarus	Russia	Germany	<i>Poland</i>
	2005	Russia	Latvia	Germany	Russia	Germany	Poland
Macedonia	1985	...	...	...	...	...	...
	1995	Bulgaria	Germany	Italy	Germany	Bulgaria	Italy
	2005	S&M	Germany	Greece	Russia	Germany	Greece
Romania	1985	Germany	Italy	US	Egypt	Germany	Iran
	1995	Germany	Italy	France	Germany	Italy	Russia
	2005	Germany	Italy	France	Italy	Germany	Russia
Slovak Republic	1985	...	...	...	...	...	...
	1995	Czech Republic	Germany	<i>Austria</i>	Czech Republic	Russia	Germany
	2005	Germany	Czech Republic	Austria	Germany	Czech Republic	Russia
Slovenia	1985	...	...	...	...	...	...
	1995	Germany	Italy	Croatia	Germany	Italy	Austria
	2005	Germany	Italy	Croatia	Germany	Italy	Austria

S&M – Serbia and Montenegro, T&T – Trinidad and Tobago, UAE – United Arab Emirates.

Note that trading partners marked in **bold** indicates that trade exceeds 20%, whilst *italicised* trading partners indicate that trade is less than 5%. The key trading partners are calculated from annual volume of trade data for exports and imports (cif) from the IMF Direction of Trade Statistics (DOTS).

Table 12. Concordance and Correlation Statistics

	US	UK	JP	AG	BB	BR	CB	CL	MX	PE	TT	UG	BS	HK	IN	KO	MY	PK	PH	TK	IV	MI	NG	SG	SA	IS	JO	MC	HN	LT	MK	RM	SX	SJ
US	.	0.77**	0.63	0.58	0.61	0.68	0.70	0.66	0.70*	0.61	0.62	0.61*	0.77*	0.58*	0.79*	0.79*	0.70	0.69	0.68	0.67	0.57	0.58	0.5	0.62	0.55	0.81**	0.65	0.6	0.67	0.34**	0.43	0.56	0.61	0.52
UK	0.39**	.	0.58	0.53	0.58	0.66	0.67	0.63	0.61	0.45	0.61	0.50	0.64	0.49	0.76	0.74	0.71	0.68	0.69	0.64	0.44	0.57	0.55	0.57	0.54	0.68	0.66	0.67	0.66	0.34**	0.43	0.58	0.61	0.52
JP	0.08	-0.04	.	0.61	0.66	0.70*	0.55	0.61	0.69	0.59	0.65	0.40	0.64	0.49	0.66	0.70	0.71	0.52	0.75*	0.64	0.44	0.57	0.63	0.51	0.64	0.54	0.62	0.63	0.56	0.45	0.55	0.67	0.77	0.71
AG	0.15	0.03	0.22	.	0.53	0.66	0.58	0.45	0.58	0.63	0.58	0.63	0.53	0.55	0.53	0.55	0.61	0.45	0.68	0.66	0.50	0.61	0.55	0.55	0.37	0.61	0.39	0.58	0.53	0.50	0.71*	0.58	0.63	0.66
BB	0.14	0.07	0.27**	0.04	.	0.40	0.57	0.59	0.59	0.55	0.59	0.60	0.54	0.53	0.56	0.56	0.55	0.58	0.49	0.58	0.54	0.57	0.65	0.74**	0.52	0.48	0.6	0.57	0.50	0.57	0.39	0.73**	0.57	0.65
BR	0.19	0.15	0.35*	0.32*	-0.23	.	0.64	0.64	0.52	0.76*	0.58	0.46	0.68	0.42	0.68	0.70	0.74	0.40	0.80**	0.66	0.48	0.46	0.58	0.44	0.74**	0.70	0.64	0.58	0.72	0.45	0.45	0.62	0.73	0.71
CB	0.20	0.16	-0.07	0.15	0.01	0.17	.	0.60	0.52	0.64	0.66	0.52	0.66	0.53	0.70	0.69	0.69	0.60	0.71	0.80**	0.51	0.54	0.54	0.39	0.49	0.70	0.69	0.54	0.67	0.61	0.52	0.64	0.66	0.60
CL	0.14	0.07	0.06	-0.13	0.11	0.17	0.02	.	0.68	0.6	0.66	0.63	0.69	0.56	0.67	0.65	0.76*	0.61	0.72	0.65	0.55	0.48	0.56	0.55	0.73*	0.67	0.59	0.64	0.53	0.41	0.45	0.59	0.77	0.69
MX	0.28**	0.07	0.28**	0.15	0.12	-0.04	-0.12	0.25*	.	0.45	0.66	0.59	0.63	0.46	0.63	0.61	0.62	0.67	0.66	0.59	0.57	0.54	0.64	0.62	0.53	0.65	0.59	0.64	0.45	0.36*	0.59	0.47	0.55	0.44
PE	0.12	-0.27**	0.1	0.27**	0.06	0.43**	0.16	0.13	-0.17	.	0.66	0.52	0.67	0.44	0.61	0.65	0.58	0.40	0.56	0.63	0.66	0.44	0.49	0.30	0.59	0.63	0.58	0.57	0.68	0.43	0.43	0.71*	0.80	0.75
TT	-0.10	-0.11	0.07	...	0.07	-0.23*	0.08	0.08	0.15	0.23*	.	0.51	0.67	0.44	0.77*	0.71	0.76	0.55	0.70	0.73	0.51	0.44	0.58	0.63	0.53	0.57	0.69	0.84**	0.67	0.64	0.45	0.64	0.91**	0.79*
UG	0.33**	0.07	-0.17	0.30**	0.23*	0.01	0.08	0.34**	0.24*	0.07	0.12	.	0.44	0.61*	0.44	0.42	0.47	0.54	0.45	0.50	0.64*	0.53	0.53	0.60	0.48	0.66**	0.44	0.45	0.48	0.39	0.52	0.49	0.39	0.46
BS	0.33**	-0.04	0.03	...	-0.06	...	-0.01	0.16	0.06	0.25*	-0.09	-0.06	.	0.43	0.86**	0.8	0.73	0.56	0.73	0.68	0.52	0.49	0.43	0.63	0.60	0.70	0.68	0.65	0.74	0.57	0.39	0.58	0.84	0.73
HK	0.32**	0.10	0.08	0.16	0.11	0.02	0.11	0.24*	-0.01	-0.09	0.02	0.20*	0.00	.	0.43	0.47	0.46	0.57	0.48	0.47	0.33*	0.62*	0.42	0.46	0.41	0.55	0.35	0.38	0.35	0.55	0.64	0.51	0.36*	0.42
IN	0.35**	0.23*	-0.13	...	-0.17	...	...	-0.13	-0.14	...	-0.10	-0.02	0.44**	0.16	.	0.94**	0.87	0.70	0.83	0.82	0.48	0.55	0.51	0.68	0.56	0.72	0.78	0.77	0.80	0.57	0.39	0.61	0.84	0.73
KO	0.35**	0.18	0.15	0.10	-0.07	0.20*	0.05	-0.07	-0.09	0.20*	-0.16	-0.11	0.19	0.20*	0.61**	.	0.87	0.68	0.81	0.82	0.44	0.57	0.49	0.66	0.56	0.70	0.72	0.73	0.74	0.45	0.41	0.64	0.77	0.67
MY	-0.02	0.05	0.18	0.25*	-0.11	0.34**	0.11	0.34**	-0.07	-0.04	0.08	0.07	-0.15	0.18	-0.06	0.24*	.	0.69	0.90**	0.85	0.45	0.50	0.54	0.63	0.65	0.65	0.73	0.76	0.69	0.45	0.45	0.57	0.82	0.71
PK	0.18	0.17	-0.19	-0.09	0.07	-0.20*	0.07	0.02	0.21*	-0.35**	-0.29**	0.16	-0.28**	0.29*	-0.12	-0.05	-0.03	.	0.69	0.68	0.52	0.59	0.49	0.62	0.46	0.66	0.66	0.53	0.52	0.30*	0.48	0.40	0.25**	0.27**
PH	-0.02	0.04	0.33**	0.42**	-0.25**	0.52**	0.22*	0.21*	0.11	-0.07	-0.11	-0.02	-0.03	0.19	-0.08	0.07	0.50**	0.04	.	0.81	0.51	0.52	0.54	0.55	0.65	0.67	0.69	0.68	0.65	0.43	0.52	0.55	0.80	0.69
TK	-0.03	-0.11	-0.01	0.34**	0.02	0.15	0.48**	0.00	-0.10	0.16	0.02	0.13	-0.19	0.15	-0.08	0.15	0.28*	0.02	0.19	.	0.48	0.59	0.61	0.58	0.56	0.72	0.72	0.65	0.70	0.59	0.55	0.58	0.77	0.71
IV	0.14	0.02	-0.15	-0.01	0.07	-0.09	0.02	0.09	0.13	0.33**	-0.01	0.29**	0.02	-0.34**	-0.20*	-0.25*	-0.23*	0.02	-0.01	-0.10	.	0.37	0.51	0.51	0.60	0.58	0.56	0.49	0.62	0.32*	0.36	0.54	0.45	0.44
MI	0.17	0.15	0.14	0.24*	0.14	0.04	0.07	-0.05	0.08	-0.14	-0.17	0.06	-0.04	0.25*	0.21*	0.21*	-0.03	0.19	0.04	0.24*	-0.26**	.	0.60*	0.51	0.37	0.57	0.49	0.54	0.41	0.36	0.64	0.59	0.45	0.50
NG	-0.06	0.06	0.24*	0.10	0.29**	0.24*	0.07	0.09	0.26*	-0.02	0.13	0.07	-0.27**	-0.14	-0.18	-0.17	0.00	-0.08	0.01	0.21*	0.02	0.20*	.	0.57	0.55	0.45	0.53	0.60	0.45	0.55	0.64	0.64	0.64	0.63
SG	0.04	-0.07	-0.15	0.10	0.44**	-0.25*	-0.12	-0.06	0.11	-0.26*	0.01	0.32**	-0.15	0.03	...	0.05	-0.08	0.17	-0.26*	-0.04	0.05	0.02	0.13	.	0.45	0.49	0.52	0.63	0.46	0.61	0.34	0.63	0.57	0.56
SA	0.00	-0.02	0.22*	-0.29**	0.00	0.43**	-0.08	0.42**	-0.01	0.16	-0.08	-0.02	0.10	-0.14	-0.17	-0.07	0.24*	-0.20	0.23*	-0.04	0.20*	-0.27**	0.08	-0.18	.	0.48	0.60	0.53	0.62	0.39	0.30	0.58	0.70	0.71
IS	0.54**	0.23*	-0.07	0.20*	-0.12	0.30**	0.28**	0.22*	0.20*	0.20*	-0.11	0.39**	0.24*	0.20*	0.30**	0.20*	0.01	0.18	0.12	0.28**	0.16	0.14	-0.15	-0.15	-0.12	.	0.60	0.49	0.64	0.32	0.50	0.47	0.64	0.54
JO	-0.03	0.02	-0.02	-0.37**	0.10	0.05	0.19*	-0.13	-0.05	0.02	-0.03	-0.06	-0.08	-0.21	-0.10	-0.16	-0.15	0.02	-0.18	-0.04	0.12	-0.04	-0.01	-0.20*	0.10	-0.04	.	0.65	0.78	0.59	0.32	0.55	0.73	0.69
MC	-0.13	0.09	0.04	0.25*	0.03	-0.15	-0.24**	0.05	0.11	0.00	0.50**	-0.04	-0.11	-0.14	0.02	-0.01	0.1	-0.31**	-0.13	-0.21*	-0.05	0.08	0.18	-0.03	-0.07	-0.30**	-0.11	.	0.59	0.61	0.48	0.64	0.84	0.79
HN	0.08	0.07	-0.14	...	-0.14	0.27*	0.16	-0.23*	-0.37**	0.28**	-0.01	0.03	0.19	-0.22*	0.26**	0.06	-0.17	-0.31**	-0.21	-0.01	0.26**	-0.23*	-0.19	-0.28**	0.16	0.10	0.32**	-0.21*	.	0.57	0.39	0.58	0.84	0.77
LT	-0.47**	-0.47**	-0.16	-0.02	0.11	-0.16	0.20	-0.24	-0.30*	-0.25	0.31*	-0.20	...	0.21	...	-0.31*	-0.31*	-0.39**	-0.29*	0.13	-0.41**	-0.24	0.10	0.21	-0.30*	-0.43**	0.12	0.20	...	0.50	0.59	0.64	0.68	
MK	-0.02	-0.02	0.21	0.43**	-0.19	0.00	0.11	-0.02	0.22	-0.02	0.21	-0.02	...	0.18	...	-0.01	0.14	-0.09	0.25	0.24	-0.23	0.22	0.27	-0.29	-0.36*	0.08	-0.30*	0.25	...	0.03	...	0.41	0.55	0.45
RM	0.01	0.07	0.28**	0.15	0.44**	0.20	0.16	0.12	-0.14	0.39**	0.19	0.00	0.03	0.06	0.13	0.18	-0.04	-0.35**	-0.07	0.03	0.09	0.18	0.26**	0.20	0.14	-0.16	-0.04	0.19	0.05	0.15	-0.12	...	0.82*	0.79**
SX	-0.24	-0.24	0.40**	0.36*	0.02	0.26	0.19	0.47**	0.00	0.36*	0.62**	-0.06	...	0.22	...	0.04	0.24	-0.52**	0.28	0.32*	-0.35*	0.18	0.42**	0.02	0.24	0.08	-0.16	0.29	...	0.25	0.35*	0.60**	...	0.91**
SJ	-0.31*	-0.31*	0.33*	0.36*	0.29*	0.30*	0.07	0.27	-0.23	0.37**	0.41**	0.06	...	0.11	...	-0.05	0.1	-0.47**	0.10	0.23	-0.23	0.21	0.35*	0.01	0.33*	-0.11	0.10	0.41**	0.34*	0.35*	0.06	0.56**	0.70**	...
μ_2	0.75	0.74	0.70	0.53	0.60	0.68	0.70	0.71	0.67	0.61	0.81	0.44	0.82	0.39	0.96																			

Firstly, the synchronisation between the developed and the developing country business cycles is examined. From Table 12, it is evident that there is significant concordance between the US and Bangladesh, Hong Kong, India, Israel, South Korea, Mexico and Uruguay, whilst there is significant concordance between Japan and Brazil, the Philippines and Romania. None of the countries are significantly concordant with the UK business cycle, although the positive correlations between the UK and India and Israel are significant. In most cases where there is a strong degree of synchronisation between the developed and developing country business cycles, the developed country is one of the key procurers of the developing country's exports; for example, throughout the sample period the US was the main procurer of Israel's exports.

Secondly, the synchronisation between developing country business cycles within regional groups is examined. Within Latin America, the only significant concordance statistic is between Brazil and Peru, although there are several significant positive correlations between the Latin American cycles. Within the Asian countries, there is significant concordance between India and Bangladesh, between India and South Korea and between the Philippines and Malaysia.

From the previous turning point analysis, this lack of synchronisation between the Asian economies is surprising, especially as the sampling period covers the Asian Financial Crisis. However, it is consistent with the finding of Kose *et al.* (2003) that business cycle fluctuations in Asia tend to be country specific. There are no significant concordances between the North African countries; however Nigeria and Malawi are significantly concordant. Finally, within the Eastern European countries there is significant concordance between Romania and the Slovak Republic, between Romania and Slovenia, and between the Slovak Republic and Slovenia.

Thirdly, the synchronisation between business cycles of developing countries that are in different regions is examined. From Table 12 it is evident that the Latin American countries have the most concordant business cycles; there is significant concordance between Brazil and the Philippines and South Africa, between Argentina and Macedonia, between Peru and the Philippines, between Barbados and Senegal and Romania, between Colombia and Turkey, between Chile and Malaysia and South Africa, between Peru and Romania and Slovenia, between Trinidad and Tobago and India, Morocco, the Slovak Republic and Slovenia, and finally between Uruguay and Israel. With the exception of the significant synchronisation of the Hong Kong and Malawian business cycles, there is no significant concordance between the Asian, the African or the Eastern European business cycles.

Finally, it is interesting to note the statistical significance of the low concordance values between Lithuania and the US, the UK, Côte d'Ivoire, Mexico and Pakistan. It indicates that the relationship between these countries' business cycles and the Lithuanian business cycle is significantly countercyclical. For example, the concordance statistic between Lithuania and the US is 0.34 which implies that 66% of the time the Lithuanian cycle is in a different phase to the US. This countercyclical relationship is supported by the significant negative correlations between these countries. There are further significant countercyclical relationships between Pakistan and the Slovak Republic and Slovenia.

7 SUMMARY AND CONCLUSIONS

The classical business cycles of thirty-two developing countries have been identified using the Bry-Boschan (1971) dating algorithm and characterised using the methodology of Harding and Pagan (2002). This analysis has revealed several key findings, which expand the current knowledge of developing country business cycles and should prove useful to theorists and policy makers alike.

Firstly, the business cycles of developing countries are not significantly shorter than those of the developed countries; rather it depends on country specific factors. However, there are some clear patterns between regional groups. The Latin American and African countries tend to have significantly shorter business cycles than those of the developed countries. The North African and Eastern European cycles are on a par with the developed country cycles, whilst the Asian business cycles are substantially longer.

Secondly, the amplitude of both contraction and expansion phases is significantly greater in the developing countries than in the developed countries. The Asian countries have the greatest expansion phase amplitude, whilst the African and Eastern European countries have the greatest contraction phase amplitudes. This corresponds with both the rapid rates of economic growth experienced by most Asian countries in the second half of the twentieth century, and with the consistently poor growth rates of the African and East European countries.

Thirdly, observation of the timing of peaks and troughs suggests that business cycles are fairly synchronised amongst the Latin American countries and amongst the Asian countries. There is a clear relationship between the timing of business cycle fluctuations and periods of significant regional crises, such as the Asian financial crises. However, as noted by Rand and Tarp (2002), the more specific timing of the start of a recession appears to be determined by country-specific factors.

Finally, there are no clear patterns of concordance either within regions or between developed and developing countries. However, there are a few developing countries which are significantly synchronous with the developed countries. Bangladesh, Hong Kong, India, Israel, Mexico, South Korea and Uruguay are significantly concordant with the US business cycle; whilst the business cycles of Brazil and the Philippines are significantly concordant with the Japanese business cycle.

However, these business cycle characteristics are only concurrent with the *classical* cycle definition of the business cycle. Thus, to fully characterise the developing country business cycle it is also necessary to examine the statistical properties, or stylised facts, of the *growth* cycle.

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