A comparative analysis of the synchronisation of business cycles for developed and developing economies with the world business cycle

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Abstract

Globalisation brought about worldwide changes, including economic and financial integration between countries. This integration implied, in business cycle theory, the emergence of a common business cycle. Most developed economies seem to follow the world business cycle most of the time. However, there is little evidence of the co-movement between emerging markets, such as South Africa, and the common cycle. Factor models, using principal component analysis, were constructed for developed and developing countries with output, consumption and investment data. These factors were compared to the world business cycle. Co-movement was found between some countries and the world factor. The results suggest that there are country-specific and worldwide sources of economic shocks, which play different roles at different times in different countries. This has implications for forecasting the business cycle, especially in times of economic turmoil.

1 Introduction

The interrelatedness of the various sectors of the economy became important after financial liberalisation. Disturbances in one part of the economy can result in symptoms in other parts of the macro economy that seem far removed. Two central issues of macroeconomics are: where do disturbances originate in the system, and where are the forces that prevent the system from quick and smooth readjustment when it is disturbed (Anon: 2004)?

Globalisation has led to an interdependent worldwide economy. Moreover, globalisation means more than the freer movement of goods, services and capital across borders; it entails the faster movement of ideas (Stiglitz: 2003).

Stiglitz (2003) is of the opinion that cycles have become similar and are characterised by the emergence of a common business cycle. Three reasons for the emergence of a common business cycle are: (i) policy authorities, and in particular monetary authorities, have become efficient and have constructed frameworks to absorb shocks effectively; (ii) the private sector has also contributed by attempting to absorb shocks as a result of market reforms; and (iii) the beneficial effects of globalisation and recent shocks affecting economies appear to be more benign than before globalisation.

There are conflicting results regarding the linkages between the business cycles of developed economies. Little research has been done on the linkages of developing countries. This paper will investigate the co-movement of developed and developing countries with the world cycle. Correlation analysis and principal component analysis will be employed. The outline of the paper is as follows: section 2 is the literature review, section 3 describes the method of research and sections 4, 5 and 6

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are the results of the correlation analysis – full sample, sub-periods and principal component analysis respectively. Section 7 concludes with a presentation of the findings.

2 Literature review

Economic integration provides a channel for financial integration through the effects of expected economic activity on the expected cash flows of firms and their stock prices. If economic integration relates to the countries' co-movement of output growth, and economic activity is positively related to stock prices, which is the case, then it is not surprising to find stock prices moving together as well (Phylaktis & Ravazzolo: 2002).

The interactions of profits, investment, credit and the financial markets are enduring features of market economies, which play a central role in business cycles. The increasing global integration of capital, goods and financial markets is widely believed to have led to interdependencies between national business cycles. Institutional changes, such as free capital mobility, floating exchange rates, and the increase in international arbitrage and speculative activities, have increased interdependence among the major capitalist nations, which is likely to lead to increased synchronisation of cycles (Bordo & Helbling: 2003).

Massad (2001) posited the notion that the new economy involves changes: faster and cheaper communications, higher labour productivity, savings in the supply chain in the business-to-business sector, and improvements in inventory control. It also involves the growing integration of world markets. There is however also an increased volatility in stock prices and the terms of trade. Growing integration predisposes the world economy to more crises than before integration. The internet revolution has increased the speed of information transmission, making information cheaper and more widely available than ever before. This technological acceleration is rapidly changing the business environment. One of the implications of this increase in the availability of information is an improvement in inventory management. The optimal level of inventories is becoming smaller, so that the real economy reacts faster to demand and/or supply shocks, reducing both the length and the width of the cycle.

Shorter cycles make for an effective monetary policy (Massad: 2001). Optimal inventory management in an increasingly open international economy will imply not only shorter cycles, but most probably also more synchronised cycles than before. The synchronisation and shortening of cycles will probably also increase the volatility of international interest rates. Economies with liquidity constraints and limited access to international financial markets will suffer most. The policy prescription here is to strengthen fundamentals and to open and deepen the integration of both product and capital markets with the rest of the world. Coverage against interest rate volatility is an additional argument in favour of integrating the economies of emerging countries with the world economy.

The new economy will eventually bring with it a new cycle, and one that is synchronised all over the world. Preparations for such an environment include inter alia flexibility in all markets (Massad: 2002).

Chakraborty (2001) argued that, as economic policy reform gains momentum around the globe, so national economies are becoming more efficient and more competitive. Increased efforts towards liberalisation have stimulated innovation, encouraged efficiency and promoted growth. Globalisation together with liberalisation is expected to reduce cyclical instability. The removal of trade distortions, globalisation and international trade liberalisation will reduce the sensitivity of economic activity to conditions in any single country. Liberalisation of investment regimes and the global integration of capital markets are expected to reduce uncertainties in investment decisions and therefore dampen business cycles.

According to Chakraborty (2001) the modern economy is characterised by the following trends:

- privatisation and deregulation of businesses;

- liberalisation of trade and the emergence of market economies;
- globalisation of production and international integration of capital markets; and
- computerisation, which implies rapid innovations in computer- and network-based technologies.

Increased integration could also affect the dynamics of co-movement by changing the nature and frequency of the shocks (Kose, Otrok & Whiteman: 2005). As trade and financial linkages get stronger, the need for a higher degree of policy coordination might increase, which in turn raises the correlations between shocks associated with nation-specific fiscal and/or monetary policies. This has a positive impact on business cycle synchronisation. Shocks pertaining to changes in productivity could become more correlated if increased trade and financial integration lead to an acceleration in knowledge and productivity spillovers across countries. Increased financial integration and developments in communication technologies lead to faster dissemination of new shocks through financial markets.

Stock and Watson (2003) note that international trade flows have increased substantially since globalisation, financial markets in developed economies have become increasingly integrated, and continental European countries have moved to a single currency. These developments raise the possibility of changes, not only in the severity of international business cycles, but also in their synchronisation. Changes in the business cycle have become characterised by the greater moderation of output fluctuations. Proposed explanations of this moderation, such as changes in monetary policy and the adoption of new inventory methods, are domestic in origin, while others, such as smaller international shocks or the stabilising effects of trade, have international dimensions. According to Stock and Watson, existing research suggests little tendency towards increasing international synchronisation of cyclical fluctuations. Instead, there appears to have been an emergence of at least one cyclically coherent group: the major countries in the Euro-zone and an English-speaking group consisting of Canada, the United States (US) and the United Kingdom (UK). These authors found that the UK has become less correlated with Euro-zone countries and more correlated with North American countries. Moreover, they found that common international shocks were smaller in the 1980s and 1990s than they were in the 1960s and 1970s. This declining volatility of common G7 shocks is the source of much of the observed moderation in individual country business cycles. Moreover, this moderation of common G7 shocks is responsible, in a mechanical sense, for the failure of business cycles to become more synchronous, as one might expect given the large increase in trade. Had world shocks been as large in the 1980s and 1990s as in the 1960s and 1970s, international cyclical correlations would have increased considerably.

The correlation between business cycle synchronisation and integration is not necessarily positive. Stronger trade integration may lead to greater regional specialisation, which could lead to less output synchronisation, resulting in industry-specific shocks (Bordo et al: 2003). Increased financial integration might be an endogenous reaction to the regionalisation of real sector linkages, as the latter allow for gains from global asset diversification. Less correlated shocks (real regionalisation) and endogenous financial development are needed to account for the changes in the international business cycle, given that there is less international co-movement because of globalisation (Heathcote & Perri: 2002).

Kalemli-Ozcan, Papaioannou and Peydro (2009) found a positive association between integration and output co-movement in a cross-section of developed markets, but when country pair-fixed effects and time-fixed effects are controlled for, a negative association emerges. The within specifications reveal that a higher degree of cross-border financial integration leads to less synchronized, more divergent output cycles.

3 Method of Research

From the literature review it is evident that there are conflicting results regarding the linkages between the business cycles of industrialised countries (Helbling & Bayoumi: 2003). The case against synchronisation was posited by Doyle and Faust in 2002. However, studies using dynamic factor models found increased linkages (Kose, Otrok & Whiteman: 2005). The notion of business cycles becoming more synchronised across countries is in line with the observation that the timing and magnitude of major changes in economic activity appear increasingly similar (Bordo et al: 2003). Harding and Pagan (2003) proposed a definition of cross-country synchronisation that is an offshoot of the traditional concepts developed by the National Bureau of Economic Research (NBER) in the 1920s. These authors argue that, if cycles are synchronised, their turning points will occur more or less at the same time. They derived the statistical measure-concordance correlation, which determines whether national cycles are significantly synchronised. This approach boils down to national business cycles being in the same phase at about the same time. Some researchers think the NBER approach is too atheoretical (Harding et al: 2003). To test synchronisation researchers use standard correlations and factor-based measures. The real GDP as a measure of the business cycle is used rather than the synthetic reference cycle series used by the NBER (Stock et al: 2003).

Since the major part of previous research dealt with developed economies, this article will focus on the behaviour of emerging markets as well. To incorporate the research by Stock and Watson, the G7 countries' GDP growth will be used as a proxy for the world business cycle. The G7 countries are the US, UK, Japan, Canada, France, Germany and Italy. Standard correlations and principal component analysis will be used to test for synchronisation. The G7 factor, G7 cycle and the world cycle will be used interchangeably. The country factor and the idiosyncratic component will also be used interchangeably.

3.1 Principal component analysis

Factor models are used primarily as dimensionality reduction techniques in situations where a large number of closely related variables are used and where it is the objective to allow for the most important influences from all these variables at the same time (Brooks: 2008). It is a way of identifying patterns in data and expressing these in a way that highlights their similarities and differences (Smith: 2002). There will be only a few independent sources of variation and most of it can be explained by just a few principal components (Alexander: 2001).

Factor models decompose the structure of a set of series into factors that are common to all series and a proportion that are specific to each series (idiosyncratic variable). These models fall into two broad types: macroeconomic and mathematical factor models. What distinguishes one from the other is that the factors are observable for the former but unobservable for the latter (Brooks: 2008).

The most common mathematical factor model is principal components analysis (PCA). This is a useful technique where explanatory variables are closely related, such as when multicollinearity is present. If there are k explanatory variables in the regression model, PCA will transform them into k uncorrelated new variables.

Suppose the original explanatory variables can be denoted as x_1, x_2,... x_k and the principal components as p_1, p_2,... p_k. These principal components are independent linear combinations of the original data

$p_1 = \alpha_{11}x_1 + \alpha_{12}x_2 + \ldots \alpha_{1k}x_k$

$p_2 = \alpha_{21}x_1 + \alpha_{22}x_2 + \ldots + \alpha_{2k}x_k$

$p_k = \alpha_{k1}x_1 + \alpha_{k2}x_2 + \ldots + \alpha_{kk}x_k$

where α_{ij} are the coefficients to be calculated, representing the coefficient of the j^{th} explanatory variable in the i^{th} principal component. These coefficients are known as factor loadings. The sum of the squares of the coefficients for each component is required to be one (Brooks: 2008). No

assumption is made concerning the structure, distribution or other properties of the variable since the construction of the components is a mathematical exercise in constrained optimisations. The principal components are derived in such a way that they are in descending order of importance. If there is collinearity between the original explanatory variables, it is likely that some of the last few principal components will account for very little of the variation and can therefore be discarded. However, if the explanatory variables are uncorrelated, all the components will be required, and then using PCA makes no sense.

The principal components can also be understood as the eigenvalues of (X'X), where X is the matrix of observations on the original variables. If the ordered eigenvalue are denoted λ_i(i=1,... k) the ratio:

$\phi_i = \lambda_i / \Sigma\lambda_i$

gives the proportion of the total variation in the original data explained by the principal component i. Suppose that only the first r (0<r<k) principal component is sufficient in explaining the variation, then k-r components are discarded (Brooks: 2008). The final regression after the principal components have been formed would be y on the r principal components:

$y_t = \gamma_0 + \gamma_0 p_1 + \ldots \gamma_0 p_{rt} + u_t$

Alexander (2001) describes PCA as the kxk symmetric matrix of correlations between the variables in the matrix X. Each principal component is a linear combination of these columns, where the weights are chosen in such a way that the first principal component explains the greatest amount of the variation in X, the second component explains the greatest amount of remaining variation and so on. The principal components are uncorrelated with each other.

In this way, the principal components keep most of the important variation in the original explanatory variable, but are orthogonal. This is useful for independent variables that are very closely related. The principal component estimates will be biased estimates, although more efficient that OLS estimators since redundant information has been removed (Brooks: 2008).

If the original regression of y on x is denoted as the estimated β and it can be shown that

$\gamma_r = P'_r \beta$

where γ_r are the coefficient estimates for the principal components, and P_r is a matrix of the first r principal components, the principal component coefficients are simply linear combinations of the original OLS estimates (Brooks: 2008).

One of the limitations of this technique is that a change in the units of measurement of a varaible will change the principal components (Brooks: 2008). Data input to PCA must be stationary (Alexander: 2001). It is good practice to transform all variables to have a zero mean and unit variance before applying PCA (Smith: 2002).

3.2 The data

Financial liberalisation plays a significant role in the synchronisation of business cycles. Therefore it is important to establish when the country data used in this study was drawn from liberalised economies. The financial sector in the G-7 economies was considerably liberalised by the mid-1970s. Financial liberalisation in the Western European economies was also adopted early. Several emerging market economies in Asia, particularly those of East Asia, steadily liberalised their financial sector after 1972. They were followed by the emerging market economies of Southeast Asia. After 1995, progress in further liberalisation slowed these economies down. In the emerging market economies of Latin America, financial repression was removed in an uneven manner. After the debt crisis of 1982, financial liberalisation was neglected in this region. However, during the 1989-92 periods maximum progress took place in this direction (Kaminsky and Schmukler: 2001). South Africa was excluded from mainstream global economic developments from 1960 to 1994. Following the political and social reforms of 1994, the new South African government pursued a policy of re-integrating the country into the world economy, and of participating in the process of economic globalisation (Stals: 2002).

The objective of this study is to establish if there is synchronisation between developed and emerging markets with the world cycle. The following countries were chosen: the G7 (as a benchmark for the world cycle), the US, UK, Japan, EU, Australia, Mexico, Turkey and South Africa. The developed countries are the US, UK, Japan, EU and Australia. Australia was chosen since it is a developed market which is not part of the G7 and it is a small open, commodity-based economy, similar to South Africa. The EU consists of a few emerging markets, but overall it would be considered a developed market. The UK also forms part of the EU. The choice of emerging markets was limited to the availability of data. Mexico and South Africa form part of the more advanced emerging markets.

The macro time series data is from the I-net Bridge database. Quarterly output, consumption and investment data of the countries for the period 1961 (quarter 1) to 2008 (quarter 3) was used (except for EU data, which was only available from 1st quarter 1995, and data for Turkey and Mexico, which was available only from 4th quarter of 1991). The specification of the model was as follows: x=3 per country for 9 countries, with T=191 time series observations for each being used, with the exception of the countries mentioned above. Growth rates were used in the procedure, which means the size of the country has no direct impact on the results. The econometric procedure that extracts common components does not for example distinguish between a 2% growth rate in the US and a 2% growth rate in South Africa.

In the research on which this article is reporting, the changes in the business cycle during the period 1961-2008 were studied. The principal component method was employed to estimate common components in main macroeconomic variables (output, consumption and investment), to form a common component for each country representing the countries' business cycle. These factors were used to quantify the relative importance of the common and country (idiosyncratic) components in explaining co-movement with the world cycle in each observable aggregate over three distinct periods: the Bretton Woods period (1960 to 1972 quarter 2); the period of common shocks (1972 quarter 3 to 1986 quarter 2); and the globalisation period (1986 quarter 3 to 2008 quarter 3) (Kose et al: 2005). Firstly simple correlation analysis will be employed to see how the correlations of the country common components compared to the world factor change over the three periods; thereafter PCA will be applied to the common components to establish how synchronisation changed over the three periods. Throughout, a distinction will be made between developed and emerging markets to establish if there is a difference in co-movement with the world cycle.

4 Results of the Correlation Analysis for the Full Sample

The G7 factor is the proxy for the world cycle and captures most of the major economic events. This factor is consistent with the steady expansionary period of the 1960s, the boom in the early 70s, the recession in the mid-70s (first oil price shock), the recession in the early 80s (tight monetary policies of industrialised nations), the expansionary period of the late 80s, the recession of the early 90s, and the highly synchronised downturn of the early 2000s. The recovery in 2003 and the latest downturn in 2007 are also evident. This factor coincides with the NBER reference cycle (indicated by the squares in Figure 4.1).

4.1 The developed markets

The correlations for the developed markets over the whole sample period are shown in the table below.

he G7 factor and the US country factor exhibit some common movements. Even though the US is part of the G7 and has the largest economy, and therefore has a larger weight, there are some differences between the two factors. In the early 1970s, the G7 was expansionary and the US factor was contracting. In the mid-1990s, the US experienced an expansionary phase, while the G7 factor

was contracting. Towards the end of the 1990s, the G7 factor was in a downturn, while the US factor was booming. The correlation between these factors is 82%, suggesting that the US represents an important source of G7 economic fluctuations.

There are some periods of co-movement between the rest of the world and Japan. The major difference between Japan and the world factor is the boom in the late 1960s in Japan, when the G7 factor was contracting. In the early 1980s, the situation was similar. The correlation between the Japan factor and the G7 factor is 68%, suggesting that the G7 countries are an important source of fluctuations in Japan, although fluctuations in Japan have an important component not related to the world cycle.

There is some co-movement between the UK and the world cycle. However, there are periods when changes are country-specific, such as during the late 1960s, 1980s, 1990s and towards the end of the sample. The correlation between the UK and the world cycle is 54%, implying that fluctuations in the UK business cycle could follow those in the rest of the world, but that there are definitely country-specific factors influencing the cycle.

There is some co-movement between the EU and the world cycle. However, there are periods when changes are country-specific, such as during the late 1990s and towards the end of the sample period where the EU cycle moves counter-cyclical compared to the G7 factor. The correlation between the EU and the world cycle is 60%, implying that fluctuations in the EU business cycle could follow those in the rest of the world, but that there are definitely country-specific factors influencing the cycle.

There is little co-movement between Australia and the world cycle. Country-specific changes play a role such as during the 1960s, early 1970s, 1980s and 1990s and towards the end of the sample period where the Australian cycle moved counter-cyclically in relation to the G7 factor. The correlation between the Australian and the world cycle is 33%, implying that there are definitely country-specific factors influencing the cycle.

4.2 Emerging markets

The table below show the correlations of the emerging markets with the world cycle.

The South African factor coincides with some of the downward phases of the G7 factor. There was a downward phase in 1982 and 1985 in South Africa, but an expansion in the world cycle. This indicates that the downturn in the South African business cycle was country-specific. During the downward phase in 1991, the G7 factor and the South African factor coincided, but the G7 factor expanded towards the end of the phase. The same goes for the downward phase in 1997, where the G7 countries recovered more quickly than South Africa. The correlation between the world factor and SA is 14% for the full sample, signifying that most of the changes in the business cycle in South Africa are country-specific.

The Mexican cycle has shown co-movement with the world cycle since 1997. During the downturn of the world cycle in 1995, the Mexican cycle also contracted, but much more deeply. The Mexican cycle boomed during the world downturn in 1996. The correlation with the world cycle is 43%, indicating some co-movement with the world cycle, but suggesting that changes are also due to country-specific factors.

Turkey, which is also an emerging market, has a correlation of 13% with the world factor over the whole sample period. Troughs and peaks are deeper and higher, such as during the Asian crisis in 1997 and the crisis in 2001. This suggests, as in the case of South Africa, that fluctuations are more country-specific.

The results reported in this section suggest that that there are country-specific and worldwide sources of economic shocks to a certain extent, and that these shocks play different roles at different times around the globe. In some episodes, the country factor is more strongly reflective of domestic economic activity, while in others the domestic growth reflects the common worldwide pattern embodied in the G7 factor. It is important, however, to divide the full sample into sub-samples to take

all the different financial systems, exchange rate regimes and globalisation into account in order to establish the changes in business cycles over time.

5 Correlation analysis for the sub-periods

This part of the analysis uses the sub-periods mentioned earlier. These sub-periods are the Bretton Woods period, the common shock period and the globalisation period as proposed by Kose, Otrok and Whiteman (2005)..

5.1 Bretton Woods period (first quarter 1961 – fourth quarter 1972)

The correlation between the world factor and the US factor (74%) is high for this period. However, all the other correlations in this period are rather weak. Therefore it can be said that fluctuations during this period are the result of country-specific shocks.

5.2 Common shock period (first quarter 1973 – second quarter 1986)

The correlation between the world factor and the US factor is 94%. The US follows the world cycle closely during this period. The correlation between the SA factor and the world factor is negative at 24%, implying that when the world is in recession SA is in a boom. The negative correlation is a result of the closed economy during this period in South Africa, specifically the political sanctions during the 1980s.

In this period, the relationship between the world factor and the Japan factor was higher than in the previous period (76%), implying that the world factor played a role during this period. The change in the correlation could be the result of the OPEC recession hitting harder and faster in Japan than in the rest of the world, reflecting Japan's heavy dependence on imported oil.

During this period, the correlation of UK factor with the world cycle rose to 72%, indicating more dependence on the world cycle.

The correlation of the Australian cycle increased to 34%, which shows that country specific factors are still playing a role in the changes in the business cycle.

5.3 Globalisation period (third quarter 1986 – third quarter 2008)

In this period, the correlation is 74% between the world factor and the US factor. This is lower than in the common shock period, implying that during this globalisation period some of the fluctuations in the US business cycle were country-specific. These country-specific fluctuations can be seen in the third quarter of 1993 and between the third quarter 1998 and the third quarter of 1999.

The correlation between Japan and the world factor dropped to 42% in this period and most of the variations in the Japanese factor were country-specific. This makes economic sense, as the Japanese economy was in recession for most of the late 90s, while the rest of the world was booming. The recovery was slower than that of the world after the global downturn in 1998 because of the recession in Japan.

The correlation between the world factor and the UK factor was 64%, lower than in the common shock period. This implies that country-specific factors become more important and can be seen in the counter-cyclical behaviour in the late 1980s, 1990s and the recent downturn compared to the world cycle.

The correlation between the world factor and the South African factor is positive in this period at 22%. This implies some co-movement between South Africa and the world cycle, with most fluctuations being a result of country-specific fluctuations. There was co-movement from 1986 to 1997 in the sense that the SA factor was booming when the world economy was booming. From

the end of 1997 this changed again to a negative relationship, which can be attributed to the Asian crisis and the crisis in Argentina in 2001, which spilled over to emerging markets.

The correlation of the Turkey business cycle with the world factor in this period was 13% and most of the fluctuations during this period were country-specific. This lower co-movement was due to the Asian crisis in 1997/98. This reiterates that, as with South Africa, Turkey is an emerging market, and was seen as a risk, and was still paying the price of liberalising later than other countries. Mexico liberalised earlier, and this is reflected in the higher correlation of 43%.

From the correlations in the discussion above and in Figure 5.1, it is evident that the correlations between the world factor and the country factors changed over time. From a developed market perspective, correlations dropped and synchronisation with the world cycle slowed down (although it was still high). This supports the views of Stock and Watson (2003), Heatcote and Perri (2002) and Chakabotry (2001). Their views imply broadly that volatility is decreasing and this makes the world cycle moderate, which implies little tendency towards international synchronisation of business cycles.

From an emerging market perspective, the correlations picked up in this period support the views of Massad (2001), Stiglitz (2003), Bordo and Hebling (2003) and Kose, Otrok and Whiteman (2005), which indicated that, after globalisation, a common cycle emerges and business cycles are then more interdependent than before globalisation.

The difference between the behaviour of the developed markets and the emerging markets in the globalisation period may be attributed to the time when financial liberalisation was implemented in the various countries.

During the first period, co-movement was present in the developed markets, and this declined towards the third period. This could imply that, as time goes by and financial liberalisation gets established in the country, volatility and severity of shocks dampen. This relates to the work by Stock and Watson (2003), who found that the declining volatility of common G7 shocks is the source of much of the observed moderation in the business cycles of individual countries.

6 Results from the Principal Component Analysis

By applying PCA to all the common components per sub-period is another way of testing for co-movement with the world factor. In this section the eigenvalues of each sub-period for the first three principal components (PCs) are shown in order to see which PCs are significant. Then each significant PC's proportion is also shown (per sub-period) to determine which proportion of variability is explained. Lastly the factor loadings for each significant PC are reported to evaluate the signs and the weights of these coefficients.

The eigenvalues of the first three PCs are plotted in Figure 6.1. The eigenvalue for the three PCs are statistically significant according to the Kaiser rule of Eigenvalue >1, except that PC3 in the common shock period is not significant. The increasing value of PC1 shows the adequacy of PC1 in accounting for the variability, although PC2 and PC3 increased during the globalisation period. Hence, the declining ability of PC1 shows that not all countries had similar movement patterns.

The proportion of variability explained by each statistically significant PC is considered in Figure 6.2.

In all three periods at least more than one significant PC appears. This suggests that idiosyncratic components do play a part in signalling the changes in business cycles. In order to establish this the factor loadings should be analysed.

The significant PCs factor loadings are plotted in Figure 6.3. PC1 factor loadings for most countries have more or less the same magnitude, except for Japan, which is best explained by PC3. The signs of PC1 is also the same, indicating that PC1 does account for most of the variation, but the divergence from the G7 factor in the other significant PCs shows that idiosyncratic components did play a significant role during this period.

The significant PCs factor loadings of the common shock period are plotted in Figure 6.4. PC1 factor loadings for most countries have the same sign and magnitude, except for SA diverging with a negative sign and Australia with a low factor loading. Both these countries are better explained by PC2. This confirmed the results of the correlation analysis in section 5.

The factor loadings of the significant PCs in the globalisation period are plotted in Figure 6.5. Although PC1 factor loadings have the same sign, their magnitudes differ. This implies that there is a common component, but certain idiosyncratic components will bring changes in the business cycle.

Since the correlation analysis showed that developed and emerging markets co-move differently with the world cycle, the next part of the analysis will divide the countries into developed and emerging markets.

6.1 PCA for developed markets

Only PC1 and PC2 are significant for the developed markets. In the common shock period only PC1 is significant. In the globalisation period PC2 increased and PC1 decreased.

PC1 explains most of the proportion, especially in the common shock period.

The factor loadings for the Bretton Woods period show that although the signs are the same for PC1, some loadings (weights) are higher in PC2 (Japan and UK). This shows that, during this period, idiosyncratic components played a role in changes in business cycles.

In the common shock period, only PC1 was significant and the sign and magnitude of the loadings for most countries were the same, except for Australia. This shows the emergence of a common cycle during this period.

In the globalisation period PC1 has the same sign and magnitude for most countries – except Japan, which is better explained by PC 2 (higher loading). The same applies for Australia. This is a confirmation of the correlation analysis, in which Japan and Australia had lower correlations with the world cycle than the other countries.

6.2 PCA of the emerging markets

Due to unavailability of data, only SA and the G7 component were used for the Bretton Woods and common shock period. All three emerging markets were used for the globalisation period.

PC1 became more significant over the three periods. PC 2 was significant only in the globalisation period.

The proportion explained by PC 1 was the highest in the common shock period and declined in the globalisation period.

PC1 shows equal weights in the factor loadings, but PC2 was also significant.

Only PC1 was significant during this period, but it is clear that a negative relationship existed during this period. This confirms the results from the correlation analysis.

In the globalisation period the sign and magnitude of the factor loadings were the same for PC1, showing the emergence of the common cycle. In PC2 the loadings of SA and Turkey are higher and the G7 and Mexico are negative. There is stronger synchronisation in this period for the emerging markets, which is a confirmation of the correlation analysis done earlier.

7 Conclusion

Globalisation has led to an increase in economic integration between countries. This integration implies the emergence of a common business cycle across the globe. Previous research focused on developed economies and their interactions with the world business cycle. This article, in contrast, focused on the behaviour of emerging markets as well.

Business cycles in the US, UK, EU, Japan, Australia, Mexico, Turkey and South Africa were examined. Factor models for each country were constructed using principal component analysis with output, consumption and investment data. These factors were compared to the G7 factor – the benchmark for the world business cycle. It was found that there is some co-movement between most of the countries and the world factor. The results suggest that there are country-specific and worldwide sources of economic shocks. These play different roles at different times in different countries. In some countries, the country factor is more strongly reflective of domestic economic activity, while in other countries domestic growth reflects the common worldwide pattern embodied in the G7 factor.

To establish the changes in business cycles over time, the sample was divided into sub-samples to take all the different financial systems, exchange rate regimes and globalisation into account. Correlation and principal component analysis were employed to establish the changes in the different periods. The analysis showed that the correlations between the world and the country factors changed over time. There are clearly differences in how developed and emerging markets co-move with the world cycle. The behaviour of developed markets (although still high, lower correlations) supports the views of Stock and Watson (2003), Heatcote and Perri (2002) and Chakabotry (2001). Their views imply broadly that volatility is decreasing and this makes the world cycle moderate, which implies less international synchronisation of business cycles. The emerging markets confirm the views of Massad (2001), Stiglitz (2003), Bordo and Hebling (2003) and Kose, Otrok & Whiteman (2005), who argue that, after globalisation, a common cycle emerges and business cycles are then more interdependent than before globalisation. In a sense, this applies to the developed markets because there is definite interdependence with the world cycle.

In general it can be concluded that larger shocks increase synchronisation; this was evident in the common shock period in the analysis. It can also be seen in the current recession, where all countries follow the recent downturn globally. Therefore it can be said that a common cycle does exist, but due to financial liberalisation it is less volatile. Thus only large shocks increase the synchronisation of business cycles with the world cycles. The timing and magnitude of major changes in economic activity appear to be similar, as Bordo & Hebling (2003) found, and therefore it can be said that the business cycles will be in the same phase at more or less the same time, as Harding and Pagan (2003) have suggested.

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Table 4.1 Correlations of the developed markets with the world cycle

	G7P	AUSP	EURP	JAPP	UKP	USP
G7P	1.00					
AUSP	0.33	1.00				
EURP	0.60	0.21	1.00			
JAPP	0.68	0.13	-0.08	1.00		
UKP	0.54	0.28	0.52	0.26	1.00	
USP	0.82	0.31	0.53	0.26	0.48	1.00

Table 4.2 Correlations between the emerging markets and the world cycle

	G7P	MEXP	SAP	TURP
G7P	1.00			
MEXP	0.43	1.00		
SAP	0.14	0.03	1.00	
TURP	0.13	0.06	0.33	1.00

Table 5.1 Correlations during the Bretton Woods period

	G7P	JAPP	SAP	UKP	USP	AUSP
G7P	1.00					
JAPP	0.16	1.00				
SAP	0.03	-0.04	1.00			
UKP	0.25	0.23	0.44	1.00		
USP	0.74	-0.22	-0.01	0.11	1.00	
AUSP	0.12	0.00	0.68	-0.02	0.05	1.00

Table 5.2 Correlations during the common shock period

	G7P	AUSP	JAPP	SAP	UKP	USP
G7P	1.00					
AUSP	0.34	1.00				
JAPP	0.76	0.22	1.00			
SAP	-0.24	0.20	-0.12	1.00		
UKP	0.72	0.10	0.67	-0.45	1.00	
USP	0.94	0.34	0.58	-0.28	0.60	1.00

Table 5.3 Correlations during the globalisation period – developed markets

	G7P	AUSP	EURP	JAPP	UKP	USP
G7P	1.00					
AUSP	0.30	1.00				
EURP	0.60	0.21	1.00			
JAPP	0.42	-0.24	-0.08	1.00		
UKP	0.64	0.52	0.52	0.17	1.00	
USP	0.74	0.44	0.53	-0.13	0.54	1.00

Table 5.4 Correlations during the globalisation period – emerging markets

	G7P	MEXP	SAP	TURP
G7P	1.00			
MEXP	0.43	1.00		
SAP	0.22	0.03	1.00	
TURP	0.13	0.06	0.33	1.00

Figure 4.1 G7 factor and the National Bureau of Economic Research NBER reference dates

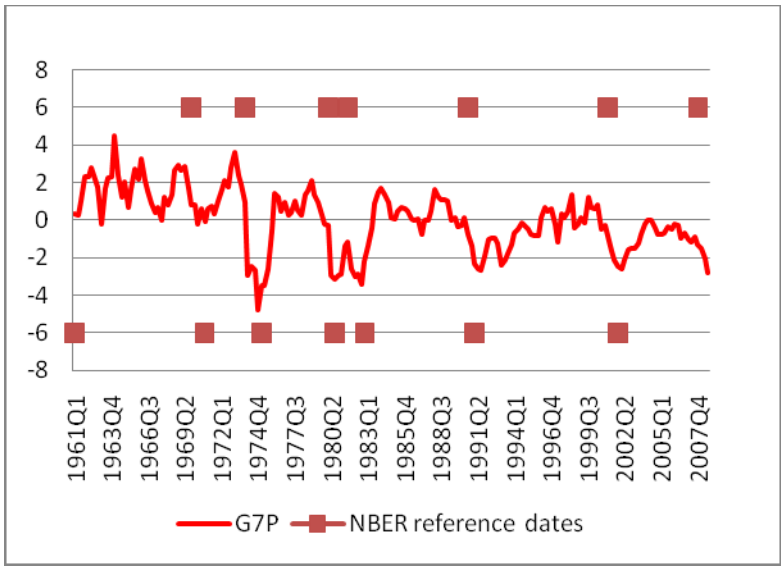

Figure 4.2 Co-movement between the G7 factor and the US factor

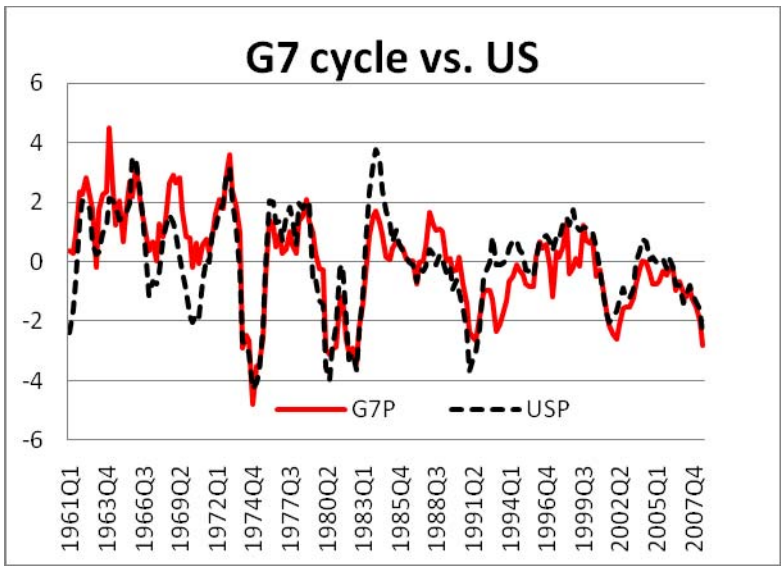

Figure 4.3 Co-movement between the G7 factor and the Japan factor

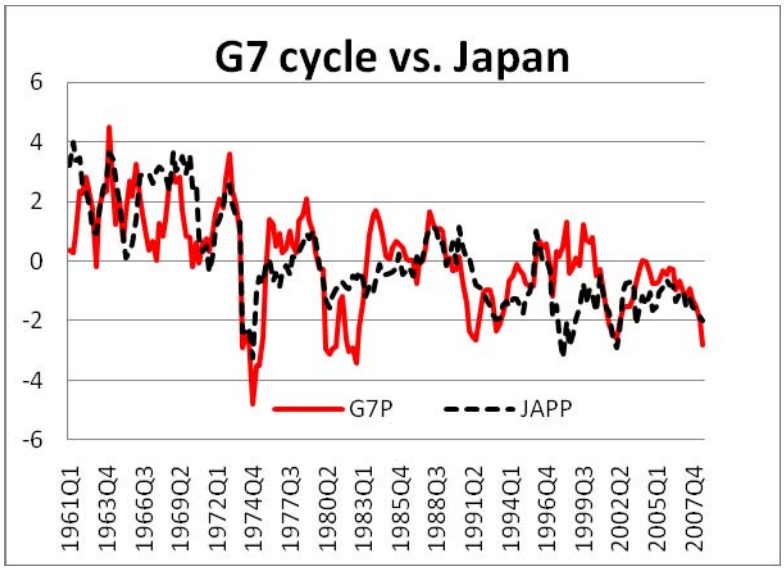

Figure 4.4 Co-movement between the G7 factor and the UK factor

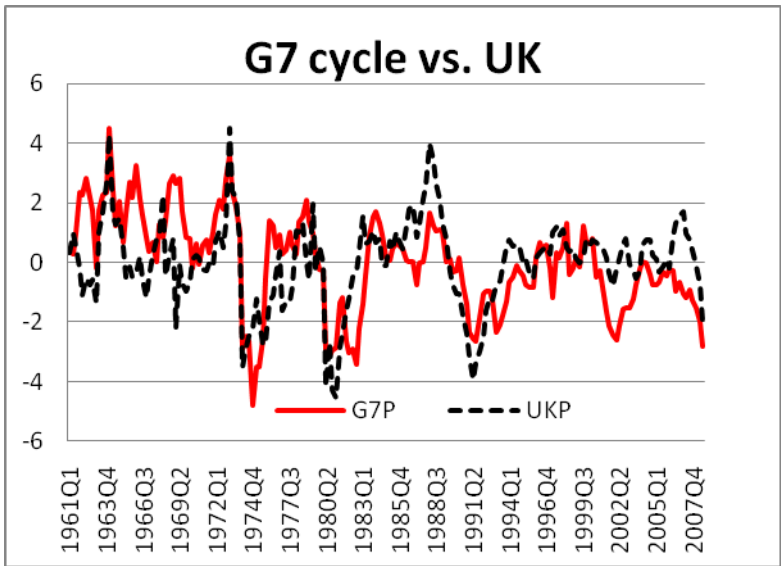

Figure 4.5 Co-movement between the G7 factor and the EU factor

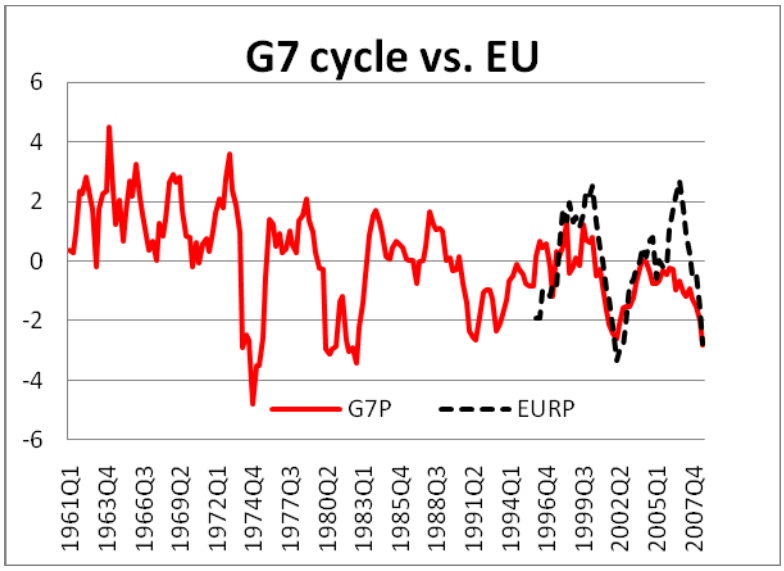

Figure 4.6 Co-movement between the G7 factor and the Australian factor

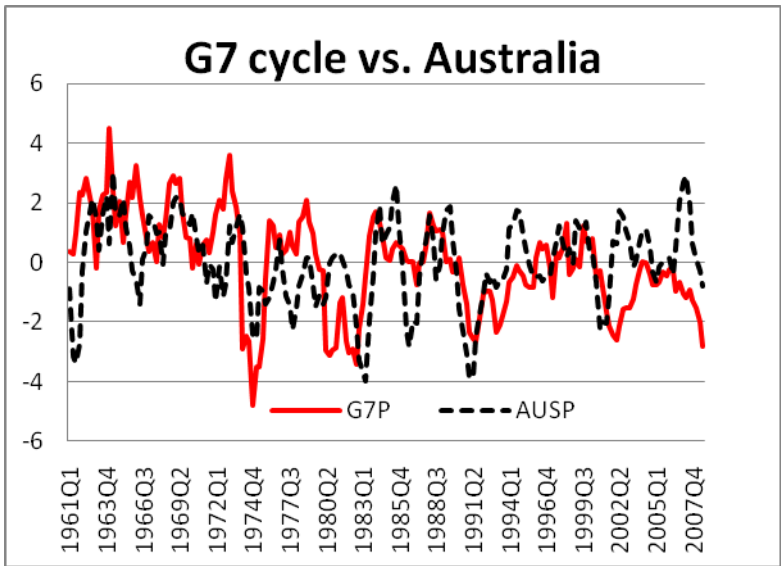

Figure 4.7 Co-movement between the G7 factor and the SA factor

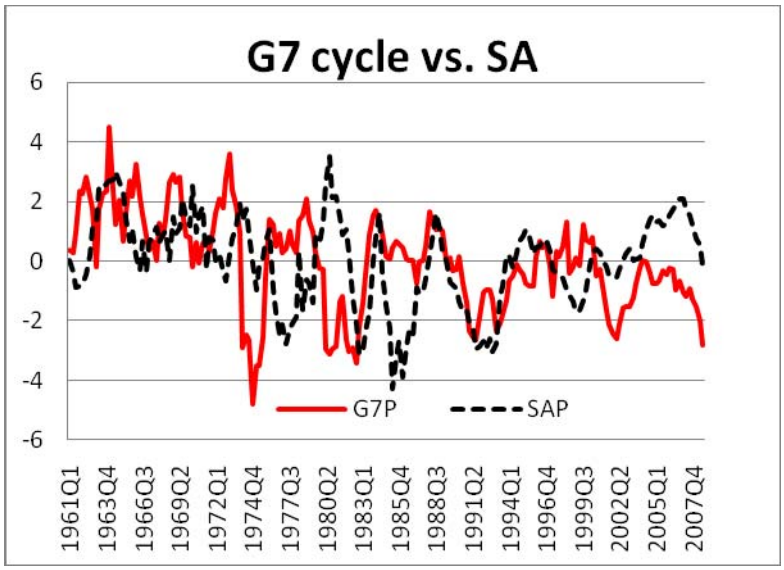

Figure 4.8 Co-movement between the G7 factor and the Mexico factor

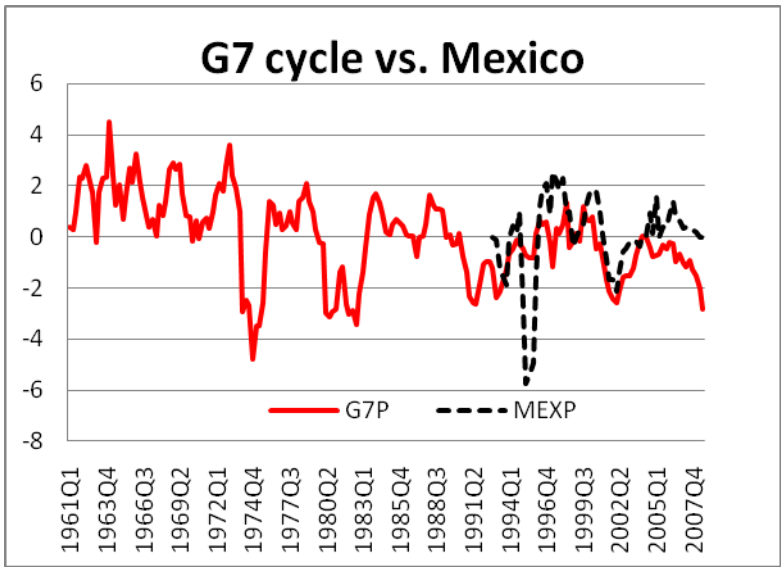

Figure 4.9 Co-movement between the G7 factor and the Turkey factor

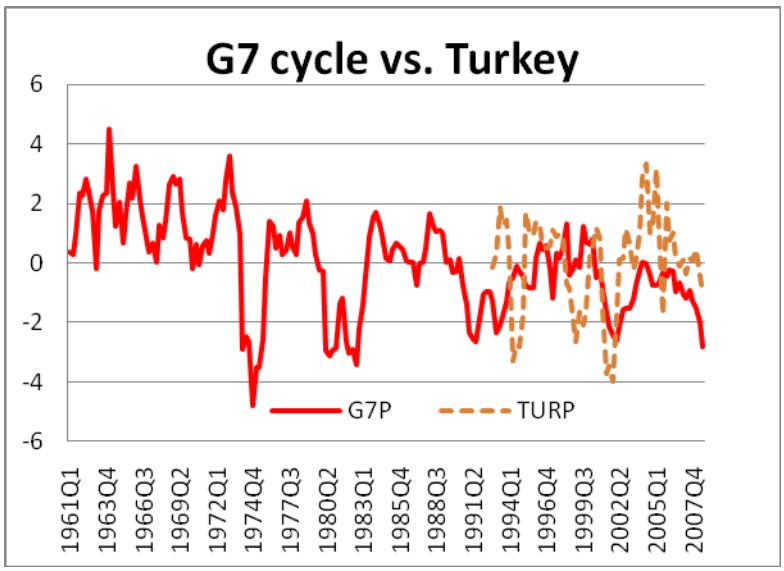

Figure 5.1 Correlations of country factors with the world factor

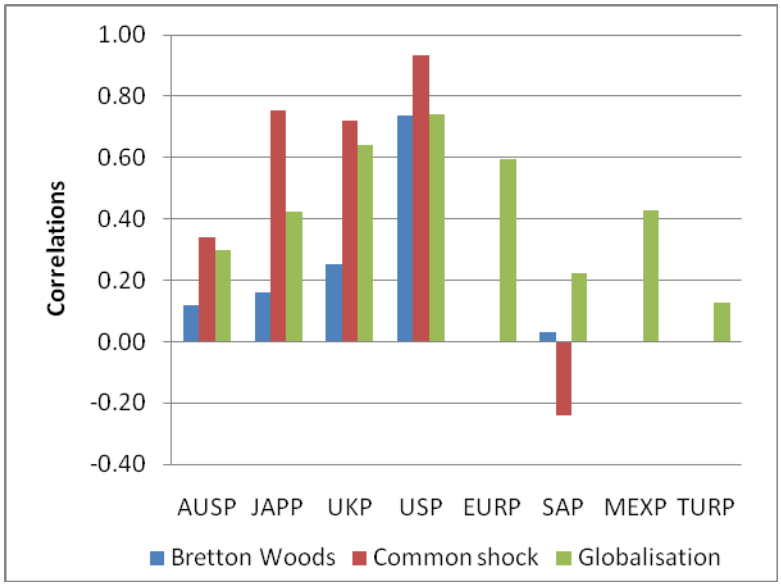

Figure 6.1 Eigenvalues from the PCA – all countries

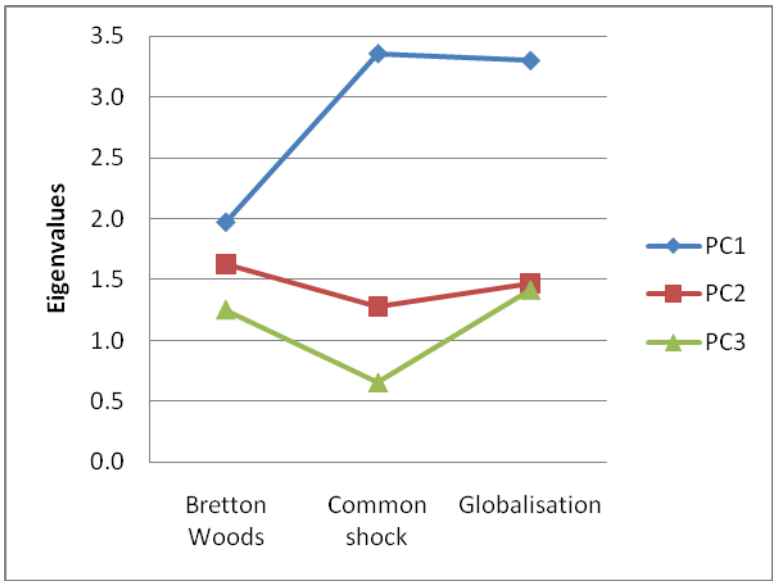

Figure 6.2 Proportion explained from the PCA – all countries

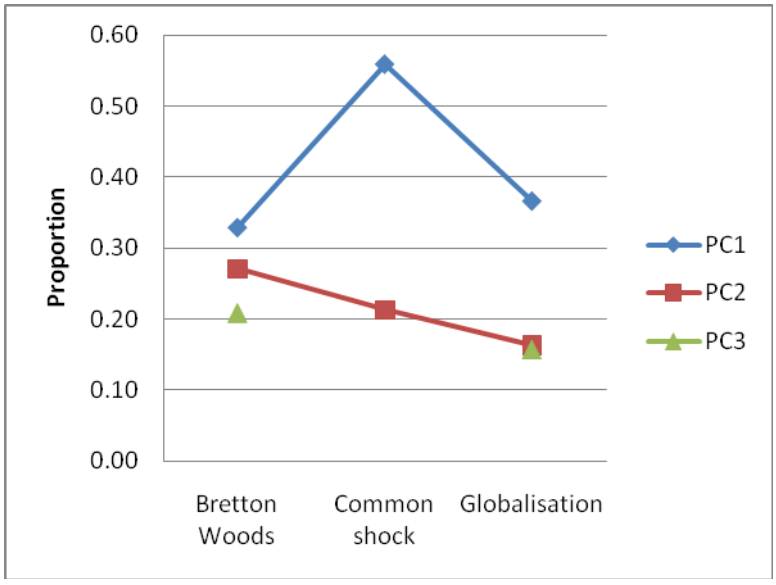

Figure 6.3 Significant factor loadings for the Bretton Woods period

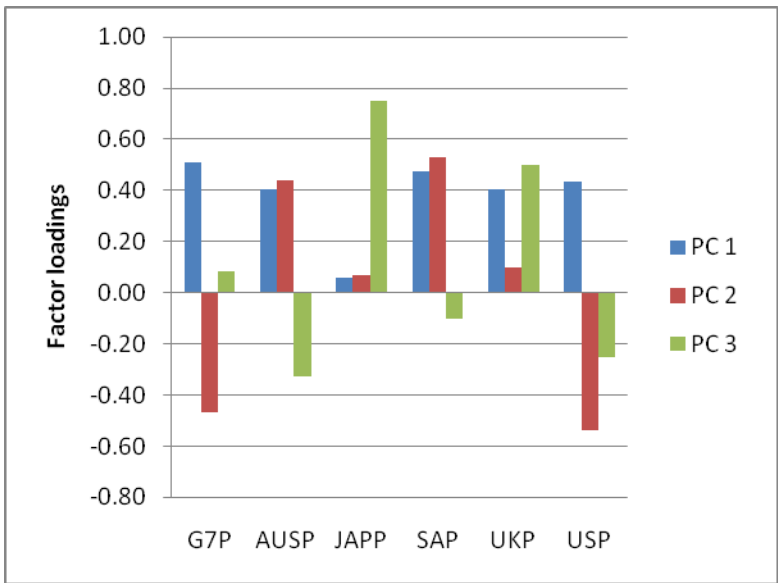

Figure 6.4 Significant factor loadings for the common shock period

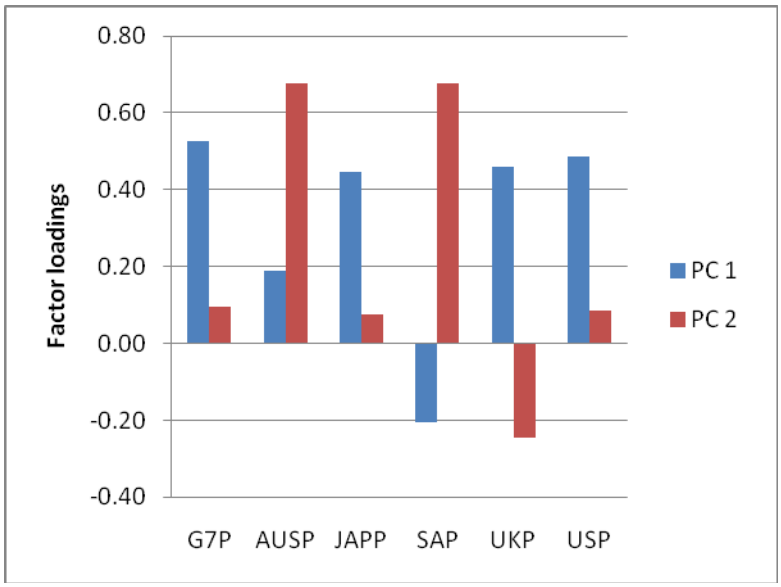

Figure 6.5 Significant factor loadings for the globalisation period

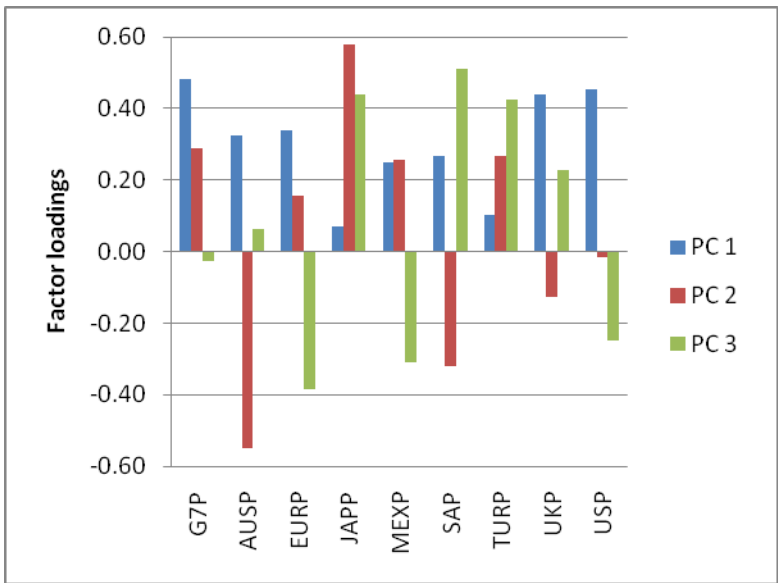

Figure 6.6 Eigenvalues from the PCA

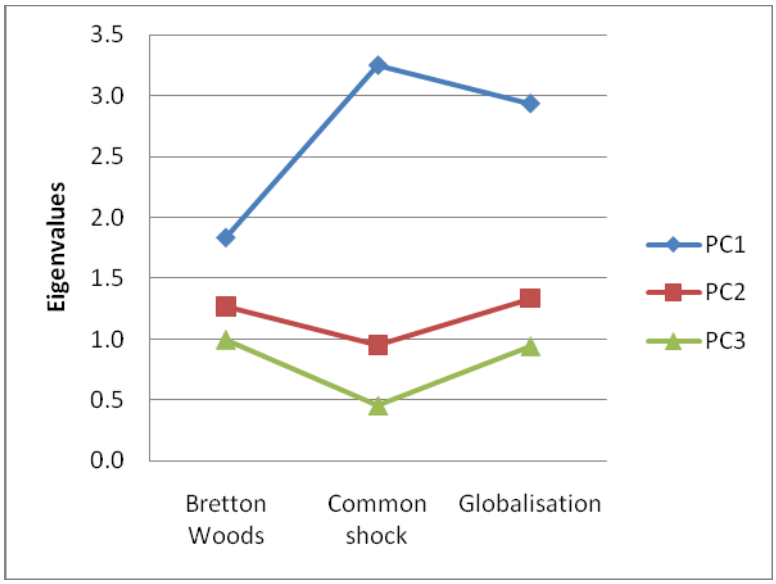

Figure 6.7 Proportion explained from the PCA

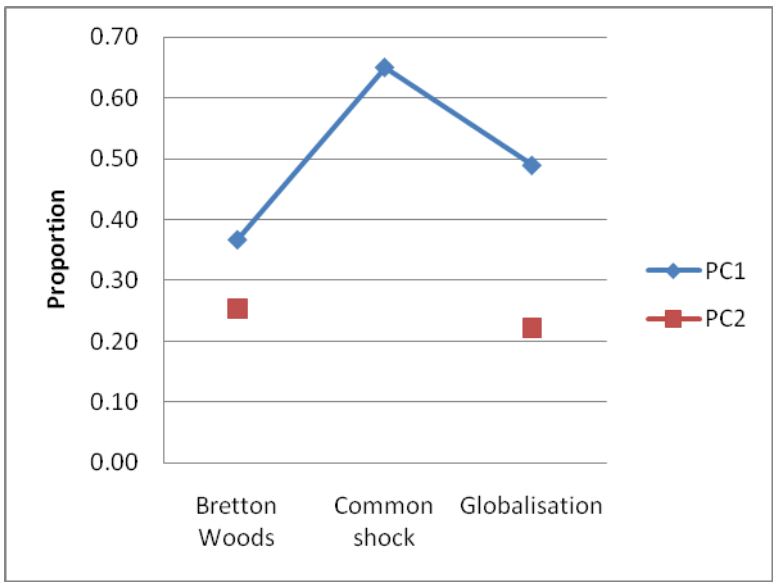

Figure 6.8 Significant factor loadings for the Bretton Woods period

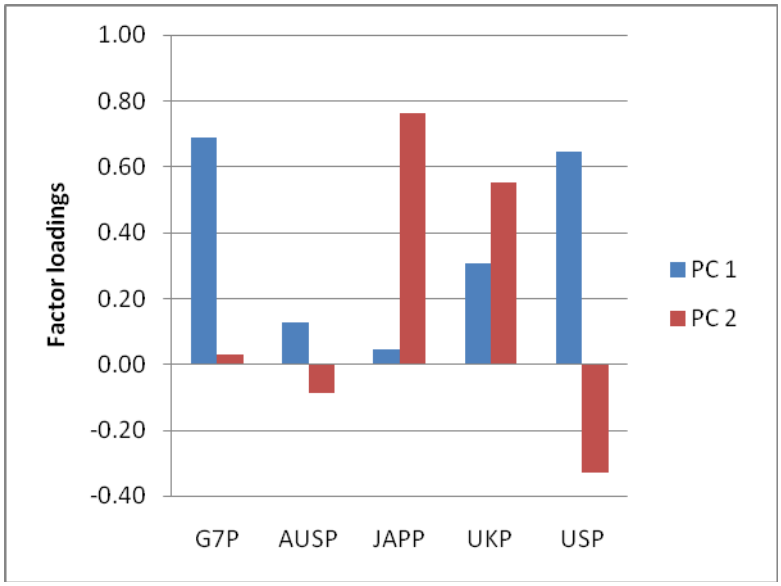

Figure 6.9 Significant factor loadings for the common shock period

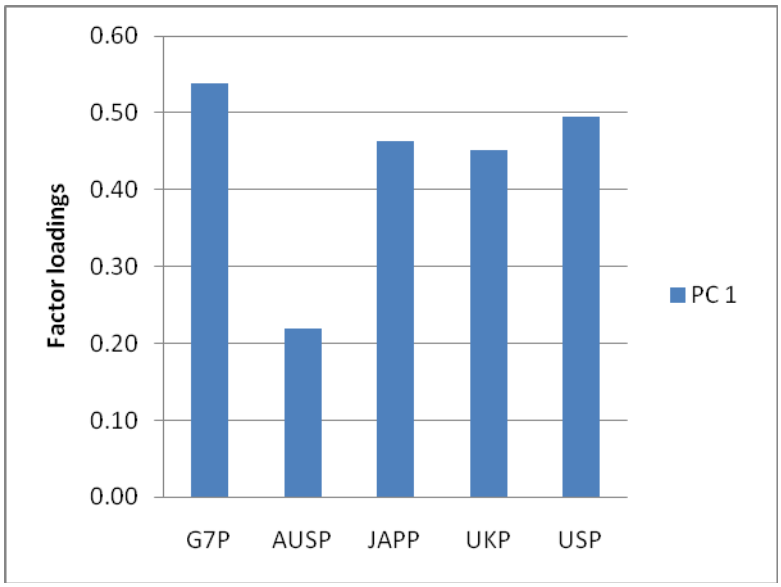

Figure 6.10 Significant factor loadings for the globalisation period

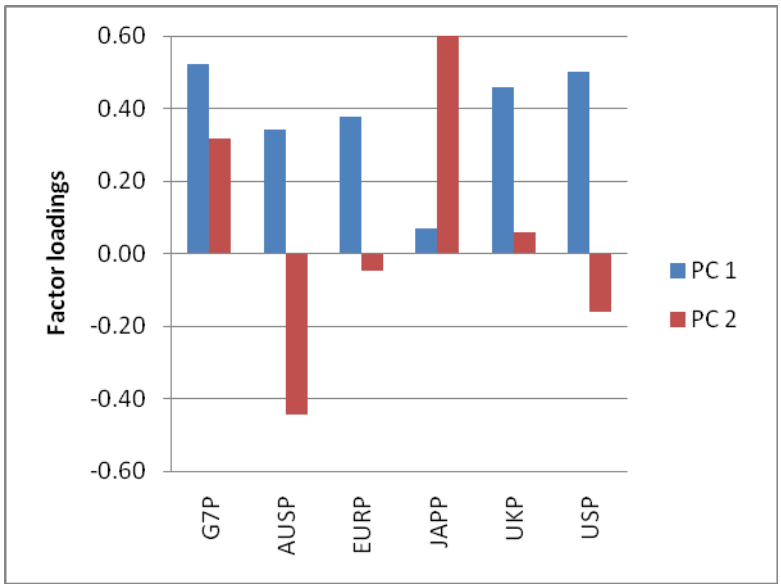

Figure 6.11 Eigenvalues from the PCA

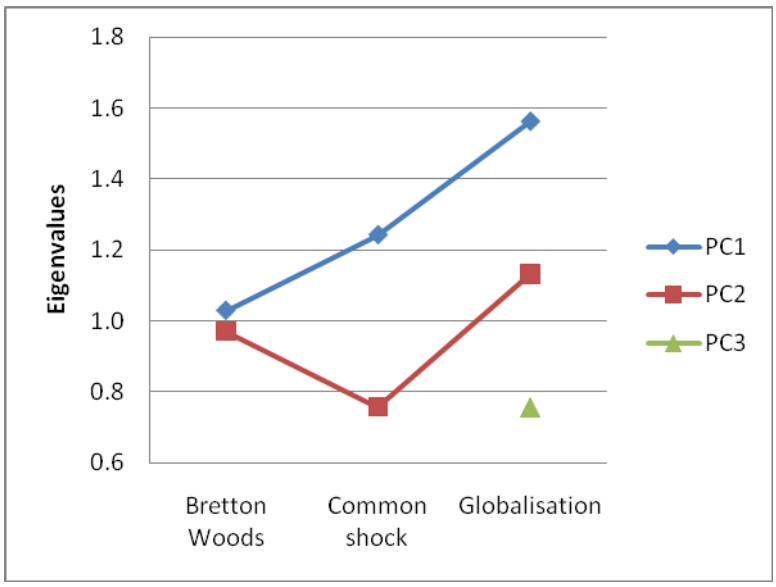

Figure 6.12 Eigenvalues from the PCA

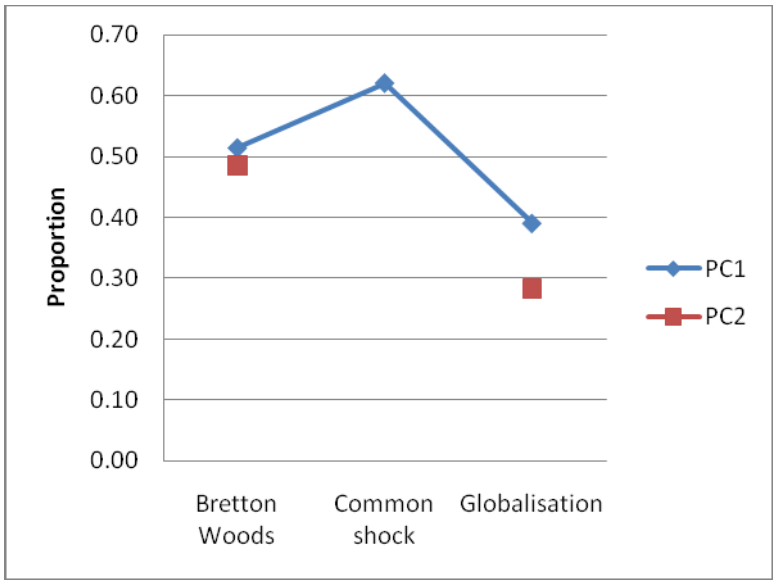

Figure 6.13 Significant factor loadings for the Bretton Woods period

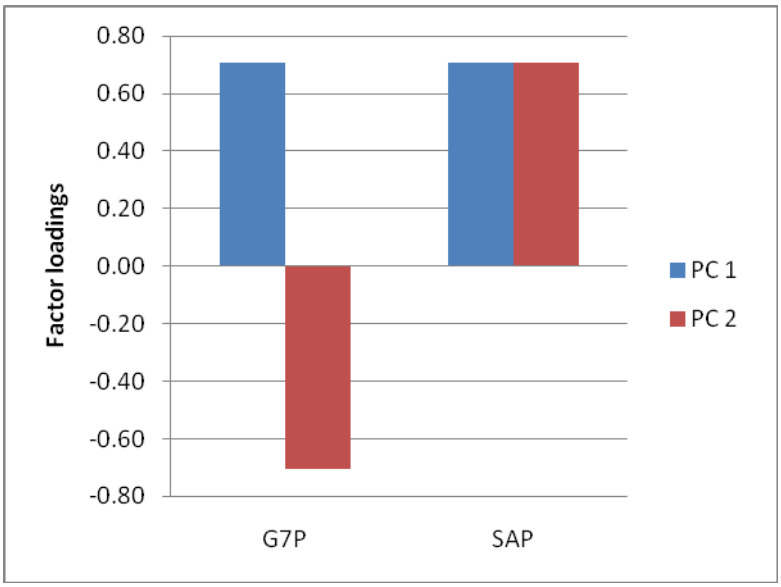

Figure 6.14 Significant factor loadings for the common shock period

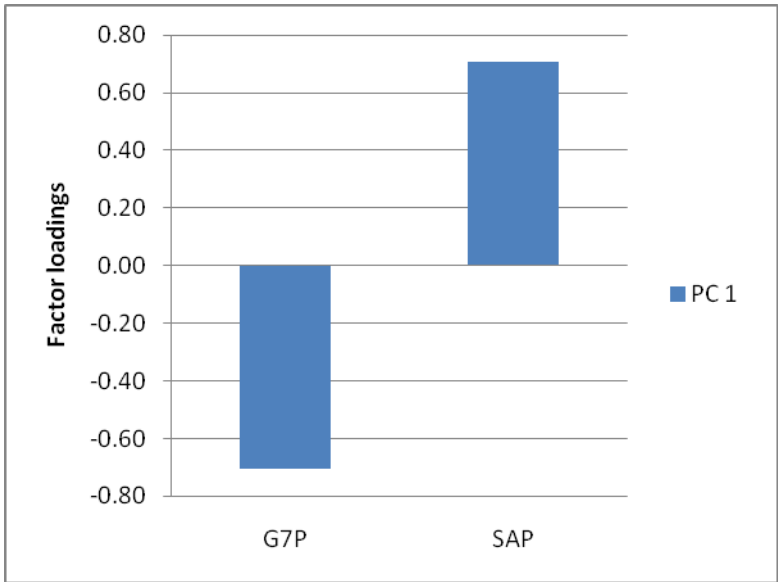

Figure 6.15 Significant factor loadings for the globalisation period