International Business Cycles Beyond G-7: The Case of India

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This paper examines the co-movements of business cycle in India, Germany, Japan, UK and USA during 1950-2000. In view of the largely closed nature of Indian economy and the dominant role of the public sector during the early period, it is interesting that the Indian business cycles have some correspondence with the business cycles in UK and also with the USA especially in the post-1980 period. The roles of foreign trade, foreign capital investment, oil-price shocks and other global shocks as the possible source of common linkage are also studied. It is shown that the oil price shock is the dominant global shock linking the economies under consideration.

Introduction

With the increasing interaction among national economies, there is more synchronisation in the level of economic activities of nations. This is more visible in the developed industrial economies where there are strong linkages in production of goods and services and also in financial flows. As developing countries become more integrated with the world economy, macroeconomic fluctuations in these countries have become increasingly affected by external influences, including business cycles in advanced countries. This has stimulated increased attention to the study of the linkages between the cyclical fluctuations in the developed and the developing countries.

This paper attempts to investigate the relationship between the cyclical movements in India and the major developed industrial countries during 1950-2000. During this period, India has been a mixed economy with roles for both the public sector and the private sector in the production process. In the post-1980 period, investment in private sector has picked up and the role of public sector has gradually declined (Annexure I). The economy was growing at an average rate of 3.4 per cent in the 1970s and picked up during the subsequent period. The trend growth was over 5 per cent in 1980s and around 6 per cent in 1990s. The share of external trade in GDP also increased over the 1980s and 1990s.

It was considered appropriate to study the relationship with the individual major trading partner countries rather than studying them *vis-à-vis* an artificially aggregated economy. This has been done to avoid the problems in aggregating economies with different structures that often do not behave similarly and many important country-specific features get cancelled out in the process of aggregation. The relationship between the Indian business cycles and the business cycles in USA, UK, Germany and Japan have been investigated as these are the major trading partners of India and are also the major countries with investments in India.

The remainder of the paper is organised in six sections. Section I briefly reviews the major studies in this area. Section II discusses the possible channels of the transmission of business cycles to the Indian economy. Section III presents the methodology and the data sources. Section IV presents the stylised facts relating to the relationship between the cyclical fluctuations in the selected economies and also discusses the impact of capital inflows. Section V analyses the impact of common shocks through a structural VAR model. Concluding remarks are given in Section VI.

Section I
Review of the Previous Studies

Backus and Kehoe (1992) examined the international evidence on the historical properties of business cycles in respect of major industrial countries. Zimmermann (1995) studied the business cycle behaviour of trade related aggregates and prices in 19 industrialised countries and compared those facts with the computational experiments of international real business cycle models. A'Hearn and Woitek (2001) studied the historical properties of business cycle for US,

Russia, Canada, Australia and major European countries for 1866-1913 and found a fairly long cycle with a periodicity of 7-10 years in all countries. They also found some evidence of a less regular and less powerful short cycle of 3-5 years duration. Canova and Dellas (1993) developed a stochastic general equilibrium model of the world economy to analyse the contribution of trade interdependence to propagation of international business cycles. Baxter (1995) developed a general equilibrium model of two countries producing a single consumption-investment good with frictionless trade and analysed its business cycle implications. It also discusses the volatility of current account and effects of shocks to government spending. Kouparitsas (1996) developed a quantitative general equilibrium model of North-South trade and argued that fluctuations in Northern aggregate output account for about 70 per cent of the variation in Southern hemisphere.

Using a Bayesian dynamic latent factor model for estimating common components in main macroeconomic aggregates, Kose *et al* (2000) investigated the common dynamic properties of business cycle fluctuations across countries, regions and the world. Their results showed that the world factor is an important source of volatility and the region-specific factors play only a minor role in explaining fluctuations in economic activity. Kwark (1999) found that the country-specific shocks to the US are important in explaining domestic and foreign (non-US G-7 countries) output fluctuations although foreign output fluctuations are partly explained by global shocks.

Canova and Marrinan (1998) studied the generation and transmission of international cycles in a multi-country model with production and consumption interdependencies. They found that a common component in the shocks best accounts for the empirically observed output dynamics and also provided evidence that country-specific shocks to the US induce comovements in the output cycles in Germany and Japan. Prasad (1999) found that nominal shocks have been an important determinant of the forecast error variance for fluctuations in the trade balance of G-7 countries in the post-Bretton Woods period. Canova and de Nicolo (2000) found that demand shocks are the dominant source of fluctuations in output, inflation and term structure of interest rates in six of the G-7 countries and, within the class of demand disturbances, the importance of

nominal shocks declined after 1982. Glick and Rogoff (1995) developed an analytically tractable empirical model of investment and the current account and found that the distinction between global and country-specific shocks turns out to be quite important for explaining current account behaviour of G-7 countries.

Lumsdaine and Prasad (1997) used time-varying weights for constructing the common component in international economic fluctuations. They found evidence for a world business cycle and also for a distinct European common component. They also found systematic differences in international business cycle relationships between the Bretton Woods and post-Bretton Woods periods. Assuming the industrial production in G-7 countries to be driven by two exogenous disturbances, Gross (2001a) found that the theoretical predictions of an open-economy model with common exogenous shocks are largely consistent with the stylised facts of the international business cycle and that country-specific and global shock appear to be equal candidates for explaining output fluctuations at business cycle frequencies across major industrialised countries. Gross (2001b) found that idiosyncratic supply shocks potentially induce changes in the current account and foreign output that vary in direction and magnitude across G-7 countries.

The relationship in business cycle fluctuations across countries also depends on the origin and magnitude of the disturbances. Economic growth of the outward-looking developing countries with capital mobility is likely to be significantly influenced by the developments in major industrial countries with which they have close trade and investment links. On the other hand, the growth pattern of inward-looking developing countries with restrictions on international capital movements is less likely to be affected by international business cycles. The literature on international business cycle has generally dealt with the co-movements in marcoeconomic fluctuations in the United States and major West-European countries with some studies also covering Canada, Australia and Japan. There has been no attempt to relate it with the similar phenomenon in other developing countries individually. The recent studies relating the various groups of countries (Kouparitsas 1996, Kose *et al* 2000, IMF 2001) suffer from problems of aggregation due to huge differences within the economic structures and regimes in countries of the "South" and non-conformity between business cycles within the "North". A study of this phenomenon in the case of a major developing economy like India and selected major developed countries would help to examine the extent of impact of international capital inflows and trade and the effect of common shocks like the changes in oil prices over different phases of international business cycle.
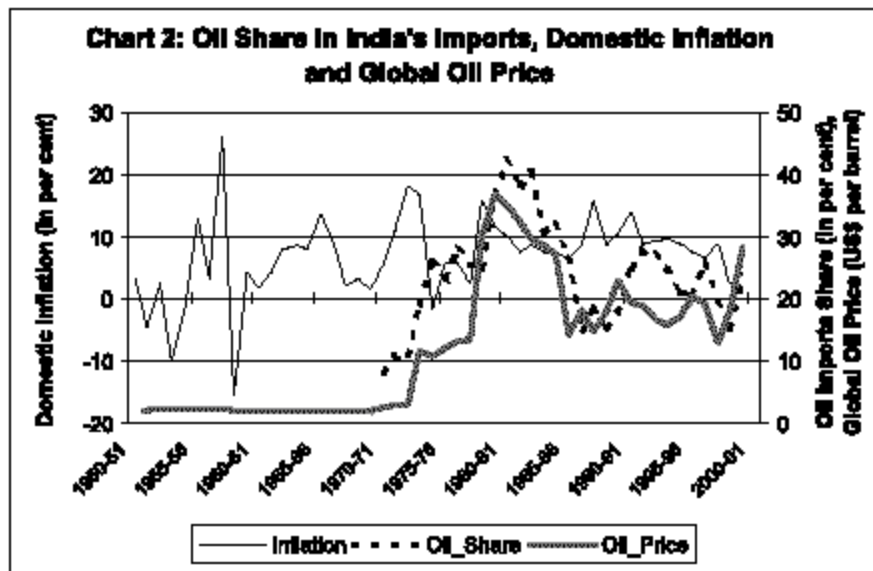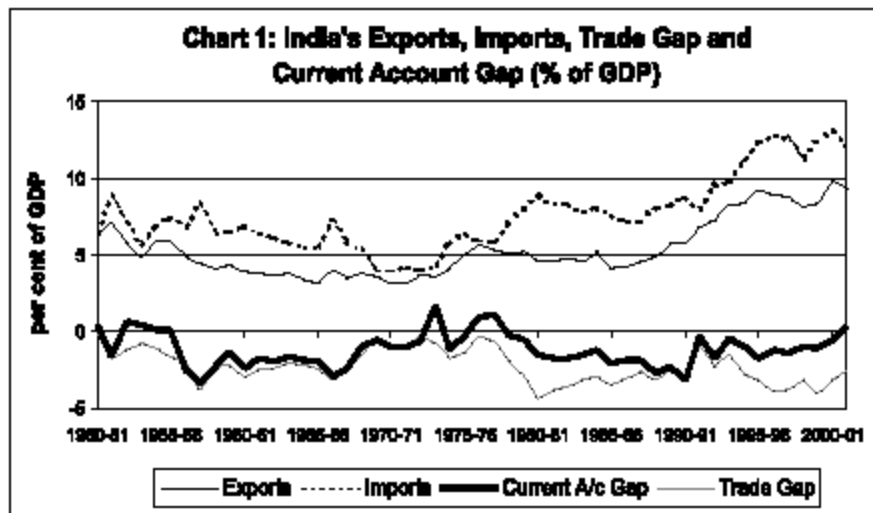
Section II
Channels of International Business Cycle Transmission

The major possible channels of synchronisation of cycles between the developed and the developing countries are common shocks, trade channel of transmission and financial market channel of transmission. Events with global impact like the oil-price shocks in the 1970s can be classified as common shocks. The depth of trade interdependence decides the strength of trade-related spillover out of disturbances in one or more countries. The integration of international financial markets and also the other international capital flows provide another strong linkage for international business cycle movements.

The OECD countries account for a major share of Indian trade (Appendix II). The oil-exporting countries are the other major trading partner block where the balance of trade is against India on account of high oil import bill. USA, UK, Germany and Japan are the four major trading partners of India. After the European unification, Belgium has become an important trading partner and is an intermediate origin/destination (largely because it has some major ports of Europe) for trading goods with other European countries, especially Germany, as the ultimate destination.

Current account deficit has been generally lower than the trade deficit in India (largely on account of high net invisibles receipts) (Chart 1). The share of both exports and imports in GDP were declining during the first two decades largely on account of the import substitution policy followed by the country. This trend in imports was reversed in 1970s and the significant increase in import bills was prominent during the two oil price shocks in the 1970s. Due to liberalisation of trade policy announced in the late 1980s and 1990s, there has been an acceleration in both imports and exports subsequently.

Chart 1: India's Exports, Imports, Trade Gap and Current Account Gap (% of GDP)

Chart 2: Oil Share in India's Imports, Domestic Inflation and Global Oil Price

The international oil prices have a major influence on the world economy since the 1970s. The increases in global oil prices resulted in substantially inflated oil import bill for India and were also followed by high domestic inflation (Chart 2). With juxtaposition on Chart 1, it can be seen that other imports were reduced with increasing oil-imports bill during the periods of oil price shocks. As oil shocks were the most prominent common shocks during the reference period for the economies under consideration, this phenomenon is examined in detail later in this paper.

Section III
Methodology and Data Sources

The official quarterly estimates of national income and related aggregates for India are available only since April-June quarter of 1995 and therefore, annual estimates for 1950-2000 are used for this analysis. Data in respect of India are taken from the official sources like the publications of the Central Statistical Organisation and the Reserve Bank of India. The estimates for other countries are taken from the International Financial Statistics (IFS) database of the International Monetary Fund (IMF). In view of the German Unification in 1989, consistent long-term time series on certain major macroeconomic variables are not available and, therefore, the relationship has been explored only for the pre-unification period in respect of Germany. In the case of India, cyclical fluctuation in the non-agricultural GDP is taken as output cycle instead of total GDP as agricultural output in India is largely weather dependent and interaction of market forces has lesser role to play in determining its level. Also the cyclical component of non-agricultural output is more strongly related to cyclical components of other macro variables like private consumption, investment, manufacturing sector output, value added from domestic trade, construction activity, private corporate sector output and sales (Mall 1999).

The cyclical components of annual economic time series are estimated by using the band-pass filter proposed by Baxter and King (1999) which uses the frequency domain approach and allows the users to choose the band of cyclical component. For estimating the cyclical components, log transformation of the annual series has been taken and the band-pass filter is used to isolate the component of time series lying within a band of frequencies between two to eight years.

Section IV
International Business Cycles and India –The Correspondence

Among the four developed industrial countries, the business cycle movements are varied from strong (UK & USA, Germany & USA and Germany & UK) to weak (Japan & UK and Japan & USA) (Table 1 and Chart 3). There has been a change in the pattern of relationship over time, for example, the Germany/USA relationship has become stronger over time (post-1960 correlation of 0.56 increased to 0.83 in the post-1970 period) whereas the Japan/USA relationship has been moving in opposite direction (post-1970 correlation was 0.40 which changed to -0.06 in the post-1980 and further to -0.72 in the post-1990). The Germany/Japan relationship became more significant in the post-1970 period. The positive impact of the 1970s (the major oil-shock period) on the relationship is obvious.

Chart 3: Real Output Cycles for Selected Countries
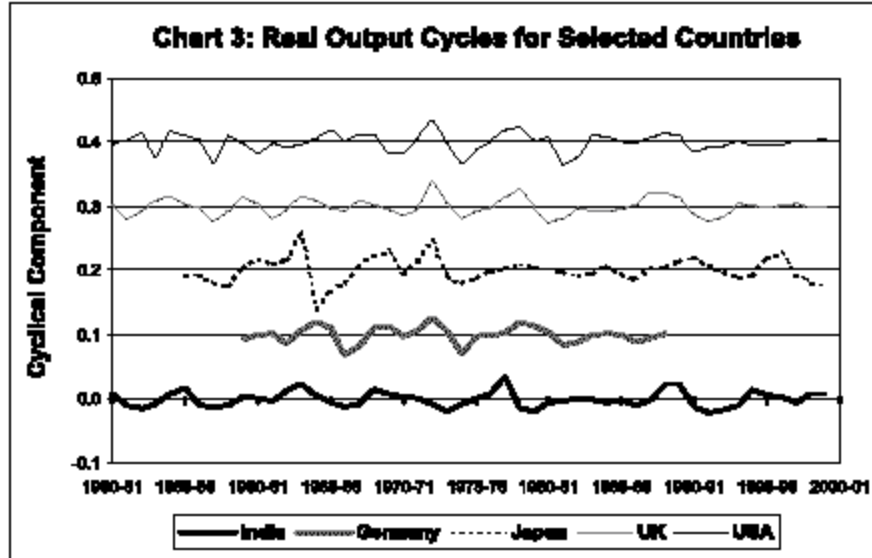
Note: Curves have been shifted up for illustrative purposes.

Table 1: Correlation of the Output Cycles for Selected Countries (1950-2000)

Country / Period		USA	UK	Japan	Germany
With India	**All Period**	0.09	0.35	0.20	0.08
	Post-60	0.13	0.30	0.18	0.08
	Post-70	0.22	0.27	-0.03	-0.18
	Post-80	0.35	0.65	0.01	0.08
	Post-90	0.37	0.71	-0.23	N.A.
With Germany	**All Period**	0.56	0.46	0.25	
	Post-60	0.56	0.49	0.25	
	Post-70	0.83	0.64	0.77	
	Post-80	0.86	-0.13	0.45	
	Post-90	N.A.	N.A.	N.A.	
With Japan	**All Period**	0.09	0.31		
	Post-60	0.07	0.27		
	Post-70	0.40	0.39		
	Post-80	-0.06	-0.04		
	Post-90	-0.72	-0.29		
With UK	**All Period**	0.56			
	Post-60	0.62			
	Post-70	0.72			
	Post-80	0.47			
	Post-90	0.64			

N.A. – Not Available

The nature of relationship of output cycles in India with the output cycles in the other four countries is very interesting. There is a positive relationship between the Indian and the UK output cycles and it has strengthened over time. Due to historical reasons, India has strong trade relationship with the UK. The co-movement between output cycles of India and the USA is also

increasing especially during the 1980s and the 1990s. There is no significant relationship of the Indian output cycles with those in Germany and Japan. The amplitude of cycles are good measure of severity of the downturn / recovery and a cycle with higher amplitude is likely to result in more impact on the trading partners. High cyclical amplitude signifies high impact of cyclical fluctuations in the economy. The amplitude of cycles (measured by standard deviation of the cyclical components) is highest for Japan (0.0203) followed by USA (0.0145), Germany (0.0134), UK (0.0132) and India (0.0124). This implies that cyclical fluctuations have more profound influence on the Japanese economy than the remaining countries.

Investment and private consumption in the selected countries are taken as other major variables for analysing the international business cycle relationship. It is interesting to note that there is a strong relationship between the private consumption cycles and the investment cycles in respect of the USA and the UK and also between the USA and Germany (Table 2). However, the same cannot be said for Japan. The co-movements of the cyclical components of investments for Germany and Japan are significant in the post-1970 period as in the case of their output co-movement during the same period but the same cannot be said for their private consumption relationship. In the case of India, the relationship with all the countries for the whole period is found negative for both private consumption and investment but turned positive for the post-1980 period. The private consumption behaviour is greatly influenced by the volatility in agricultural output. During the pre-1980 period, investment behaviour in the Indian economy was largely driven by government policies and was not necessarily driven by market forces. The public sector industries had a major share in total investment in the pre-1980 period and their share has been declining in the subsequent period. The opening up of the economy around mid-1980s witnessed more syncronised movements in these variables with other countries especially with the USA and the UK.

Table 2: Cross-country Correlation of Cyclical Components of Consumption and Investment in Selected Countries

Country / Period		USA	UK	Japan	Germany
Private Consumption Expenditure					
India	**Post-1950**	-0.11	-0.10	-0.07	-0.34
	Post-1970	-0.14	-0.13	-0.32	-0.28
	Post-1980	0.32	0.52	0.13	0.15
Germany	**Post-1950**	0.45	-0.15	-0.03	
	Post-1970	0.48	-0.04	0.44	
	Post-1980	0.14	-0.58	-0.24	
Japan	**Post-1950**	0.05	0.34		
	Post-1970	0.26	0.34		
	Post-1980	-0.17	0.09		
UK	**Post-1950**	0.42			
	Post-1970	0.66			
	Post-1980	0.64			
Gross Fixed Capital Formation					
India	**Post-1950**	0.01	0.04	0.01	0.02
	Post-1970	-0.20	-0.13	-0.32	-0.19
	Post-1980	0.22	0.27	0.14	-0.04
Germany	**Post-1950**	0.33	0.06	0.20	
	Post-1970	0.52	0.14	0.55	
	Post-1980	0.62	-0.08	0.22	

Japan	Post-1950	0.01	0.32
	Post-1970	0.29	0.38
	Post-1980	-0.17	0.20
UK	Post-1950	0.38	
	Post-1970	0.44	
	Post-1980	0.48	

Foreign Investment

The negative correlation between investment cycles in India and those in other countries for the post-1980 period is significant. On an average, over 92 per cent of investment in India is met with domestic savings (Appendix I). However, external investment had an important role (except in the 1970s when it went down drastically and was negative for three years). Chart 4 presents the share of foreign investment (as per cent of GDP) and the output cycles. These movements had low correlation in the total period (correlation coefficient = 0.10). However, a closer look shows that there is a significant difference in the relationship between the pre-1980 and the post-1980 – the pre-1980 relationship was negative (correlation coefficient = -0.28) which turned positive in the post-1980 (correlation coefficient = 0.41). The direction of causality between output cycles and foreign investment cannot be studied from these two variables as there are other factors like the state of the foreign economies, government policies, investment lags, *etc.,* that influence the relationship but the growing association between foreign investment and output cycles is extremely important. This result is consistent with the overall output, consumption and investment cycle relationship during the post-1980s when there was stronger co-movement with the USA and the UK – the two major investing countries in India.

Chart 4: Foreign Capital Investment and Output Cycles
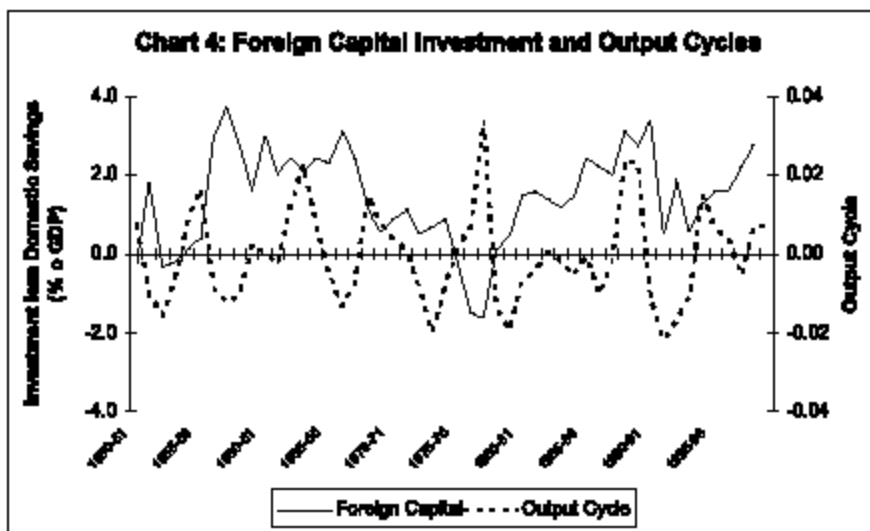
Section V
The Role of Common Shocks – A Theoretical Model

In this section, we study the the impact of common global shocks (including the oil-shocks) and country-specific shocks in propagating similar macroeconomic fluctuations across the selected countries. For this purpose, a structural VectorAutoregression (VAR) model using quarterly data for the period 1960:Q1 to 2000:Q4 is used. For this analysis, the Index of Industrial Production

(IIP) has been used as output variable for all the countries. Two quarterly VAR models are used to analyse -

(i) the impact of global shocks and country-specific shocks on output fluctuations; and
(ii) the impact of oil price shocks, other global shocks and country-specific shocks on output fluctuations.

To discriminate between country-specific and global shocks, it is assumed that impacts of global shock produce identical percentage output changes across countries and their limiting impulse responses in the level of output are also assumed identical across countries.

The output series (i.e., seasonally adjusted quarterly IIP) are found to be I(1). In view of its large size and strong trade relationship with the major economies across the globe, USA is taken as the reference country and the output differential with respect to the USA is defined as

$$Y^i = \Delta \log(IIP^i) - \Delta \log(IIP^{US}) \tag{1}$$

where i denotes the other four countries. The assumption that $Y = [Y^i, \Delta \log(IIP^i)]$ be a bivariate covariance stationary vector process for any i would imply that the elements of Y can be expressed as a linear combination of past and present structural shocks, i.e.,

$$Y_t = A(L) \, \varepsilon_t \tag{2}$$

where $\varepsilon = [\varepsilon^h, \varepsilon^g]^T$ is a vector of serially uncorrelated structural disturbances with zero mean and unit variance, h and g representing the home and global supply shocks, and A(L) is a 2×2 matrix of polynomial lags. The reduced form moving average representation

of Y is

$$Y_t = C(L) \ e_t \qquad (3)$$

where $e = [e_1, e_2]$ is a non-structural residual vector with zero mean and variance-covariance matrix Σ, and $C(L) = A(L) \times S^{-1}$ is a 2×2 matrix of polynomial lags to be estimated and S is a 2×2 matrix to be identified. The elements of e are linear combinations of the structural shocks by

$$e_t = S \times \varepsilon_t \qquad (4)$$

which implies (with normalisation $E(\varepsilon_t \varepsilon_t^T) = I$) that $\Sigma = S \times S^T$. This imposes three non-linear restrictions on the S matrix by the estimates of Σ. To recover the original VAR structure (by identifying the S matrix) by just-identification, we assume additional restriction from economic theory that global supply shock does not have long-run impact on the differential of the output level across countries. The VAR is estimated for the lag order 3 as residuals do not contain significant autocorrelations beyond the third lag.

A similar structure is used for the second VAR analysis that includes three shocks and Y is now defined as $Y = [Y^i, \Delta \log(IIP^i), \Delta \log(Price_{oil})]$. To just-identify the model, the additional restriction that oil price is solely driven by oil price shocks (*i.e.*, country-specific and global shocks have zero coefficient for the oil price equation) is imposed.

The correlation between the country-specific shocks and the global shocks before and after the oil price adjustment indicates that the the country-specific shocks are generally unrelated across the countries both before and after oil price adjustments (Table 3). In the case of India, the correlation with all other countries is less than 0.1 for country-specific shocks. In the case of Japan, the correlation with the UK or India is negligible and negative but it is marginally high with Germany. In Section IV too, the relationship in cyclical components of both output and investment in Germany and Japan were found to be high. Similar is the case with UK-Germany relationship. On the other hand, the global shocks have been more strongly related than the country-specific shocks across the countries both before and after oil price adjustments. There has been no major change in the pattern of correlations if oil price shocks are explicitly accounted for. This result is consistent with the findings of Gross (2001a). Additional calculations show that the impacts of oil shocks are near-perfectly correlated across countries (the correlation coefficient ranges between 0.991 to 0.996). This implies that oil shocks are the dominant source of business cycle comovements in the selected countries.

Table 3: Cross sectional Covariance of Identified Shocks:
Global and Country-Specific Shocks Before/After controlling for Oil Prices

Country	UK	Japan	Germany	UK	Japan	Germany
	Before Oil price Adjustment			After Oil price Adjustment		
	Country-Specific Shocks					
India	-0.004	-0.052	0.073	-0.007	-0.093	0.060
Germany	0.284	0.226		0.267	0.225	

Japan	-0.034			-0.008		
Global Shocks						
India	0.403	0.441	0.481	0.477	0.433	0.455
Germany	0.422	0.409		0.445	0.402	
Japan	0.185			0.243		

Section VI
Concluding Observations

The global economy is becoming increasingly integrated under the influence of a variety of factors like increasing trade in goods, greater technological spillover and increasing factor mobility especially, international capital flows. Over the years, this has resulted in international business cycle linkages in the developed industrial countries in Europe and they often have phases of synchronised relationship with the US business cycles. However, its relationship with other parts of the world is not yet strong. The Japanese business cycle is one such example. In view of the non-synchrony and changing structures, international business cycle analysis using artificially aggregated economy is prone to cancelling out many interesting and relevant country-specific factors.

The analysis in this paper shows that the Indian output cycles have positive relationship with the UK output cycles and also with the USA output cycles especially during the post-1980s, though the latter relationship is weaker than the former. Also, the relationship between Indian investment or private consumption cycles and the respective cycles in other selected countries turned positive in the post-1980 period. This can largely be attributed to the closed nature of Indian economy and the institutional set-up in the earlier years. This relationship has undergone changes in the light of the declining public sector investment and also due to the opening up of the economy which has led to increased factor movements with other economies.

The synchronised output cycles can largely be related to the international oil price shocks for all the countries. Though non-oil global shocks were important in transmission of international business cycles, the oil price factor which cannot be considered endogenous to the economies analysed here, has been the dominant factor driving the international business cycle relationship through global shocks for major part of the period.

Appendix I:
Indian Economy - Selected Ratios & Growth Rates

(A) Selected Ratios

Variable	1950-51	1970-71	1980-81	1990-91	2000-01
Activity Share in Output (in %)					
Agriculture & Allied Activities	55.8	45.2	38.1	31.0	25.3
Mining, Manufacturing & Electricity	12.4	17.0	20.9	23.3	20.2
Services	31.8	37.8	41.0	45.7	54.5
Average Saving Rate (% of GDP)	10.8	13.5	18.9	19.3	23.1
Average Investment Rate (% of GDP)	12.0	15.6	19.1	22.0	24.3

	NA	13.8	19.7	26.3	25.7
Public Sector share in GDP (per cent)	NA	13.8	19.7	26.3	25.7
Public Sector share in Investment (per cent)	NA	38.1	41.4	38.6	31.1

Degree of Openness	1950-60	1960-70	1970-80	1980-90	1990-00
Exports (% of GDP - Average)	5.7	3.9	4.4	4.7	8.0
Imports (% of GDP - Average)	7.5	6.2	5.6	8.0	10.9
Current Account (% of GDP - Average)	-1.0	-1.8	-0.1	-1.8	-1.3

(B) Selected Growth Rates - per cent per annum
(Average of Decades)

Variable	1950-60	1960-70	1970-80	1980-90	1990-00
Trend Annual Growth rate (based on Real GDP)	3.6	3.2	3.4	5.2	6.0
Trend Annual Inflation (based on GDP deflator)	1.2	7.3	7.6	7.8	8.2

Source: Compiled from-
(i) National Accounts Statistics, Central Statistical Organisation
(ii) Reserve Bank of India Bulletin

Appendix II:
Share of Selected Countries in India's Foreign Trade

(per cent)

Year\Country		Belgium	Germany	UK	USA	Japan	Saudi Arabia	Singa-pore	Hong-kong	USSR
1950-51	Exports	1.6	1.8	23.3	19.2	1.7	0.4	4.7	1.7	0.2
	Imports	1.4	1.6	20.8	18.3	1.6	0.1	2.5	0.4	0.0
1960-61	Exports	0.8	3.1	26.8	16.0	5.5	0.5	1.1	0.5	4.5
	Imports	1.4	10.9	19.4	29.2	5.4	1.3	0.9	0.1	1.4
1970-71	Exports	1.3	2.1	11.1	13.5	13.3	0.9	1.3	1.2	13.7
	Imports	0.7	6.6	7.8	27.7	5.1	1.5	0.1	0.0	6.5
1980-81	Exports	2.2	5.7	5.9	11.1	8.9	2.5	1.7	2.2	18.3
	Imports	2.4	5.5	5.8	12.1	6.0	4.3	3.4	0.3	8.1
1990-91	Exports	3.9	7.8	6.5	14.7	9.3	1.3	2.1	3.3	16.1
	Imports	6.3	8.0	6.7	12.1	7.5	6.7	3.3	0.7	5.9
1999-00	Exports	3.7	4.8	6.0	22.7	4.5	2.0	1.8	6.8	2.9
	Imports	7.4	4.0	5.8	7.7	5.0	4.8	3.2	1.7	1.7

Source: Compiled from
(i) Handbook of Statistics on Indian Economy, Reserve Bank of India
(ii) India Database: The Economy (H.L.Chandok and The Policy Group, 1989)

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