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The impact of the global financial crisis on business cycles in Asian emerging economies

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Jarko Fidrmuc and Iikka Korhonen

The impact of the global financial crisis on business cycles in Asian emerging economies

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Contents

Abstract 3

Tiivistelmä 4

1 Introduction 5

2 International transmission of business cycles 7

3 Data description 10

4 Moving correlations of international business 11

5 Dynamic correlation analysis of business cycles in emerging Asia 13

6 Factors explaining the pattern of dynamic correlations 18

7 Conclusions 21

References 23

All opinions expressed are those of the authors and do not necessarily reflect the views of the Bank of Finland.

Jarko Fidrmuc[I] and Iikka Korhonen[II]

The impact of the global financial crisis on business cycles in Asian emerging economies

Abstract

We analyze the transmission of global financial crisis to business cycles in China and India. The pattern of business cycles in emerging Asian economies generally displays a low degree of synchronization with the OECD countries, which is consistent with the decoupling hypothesis. By contrast, however, the current financial crisis has had a significant effect on economic developments in emerging Asian economies. Applying dynamic correlations, we find wide differences for different frequencies of cyclical development. More specifically, at business cycle frequencies, dynamic correlations are typically low or negative, but they are also influenced most by the global financial crisis. Finally, we find a significant link between trade ties and dynamic correlations of GDP growth rates in emerging Asian countries and OECD countries.

Keywords: Financial crisis, business cycles, decoupling, trade, dynamic correlation.
JEL classification**:** E32, F15, F41.

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Jarko Fidrmuc and Iikka Korhonen

The impact of the global financial crisis on business cycles in Asian emerging economies

Tiivistelmä

Tässä työssä tutkitaan maailmanlaajuisen finanssikriisin välittymistä Kiinan ja Intian talouksiin. Aasian kehittyvien maiden suhdannevaihtelut ovat olleet varsin erilaisia kuin OECD-maiden suhdannekehitys, mikä tukee käsitystä, että maailmanlaajuisesti suhdannevaihtelut ovat aiempaa riippumattomampia toisistaan. On kuitenkin huomattava, että maailmanlaajuisella kriisillä on ollut merkittävä vaikutus myös Aasian kehittyviin talouksiin. Työssä analysoidaan suhdannevaihteluita dynaamisen korrelaation avulla, ja saatujen tulosten mukaan suhdannevaihteluiden korrelaatio on erilainen erilaisilla frekvensseillä. Perinteisillä suhdannevaihteluiden frekvensseillä dynaaminen korrelaatio on ollut vähäinen tai jopa negatiivinen, mutta juuri näille frekvensseillä finanssikriisi on näyttänyt lisäävän korrelaatiota eniten. Tulosten mukaan OECD-maiden ja Aasian kehittyvien talouksien välinen kauppa lisää suhdannevaihteluiden korrelaatiota.

Asiasanat: finanssikriisi, suhdannevaihtelut, suhdannevaihteluiden eriytyminen, kauppa, dynaaminen korrelaatio

1 Introduction

Globalization has been perhaps the key event in the world economy in the past two decades. During this gradual process, several emerging countries have gained in economic importance and have begun to influence economic developments in other countries (Akin and Kose, 2008). This development has been dominated especially by the growing Chinese economy, supported by its export expansion into and investment from developed countries. Within a just a few years, China has become an important source of growth for the global economy. More recently, China has been followed by India and possibly also by some other smaller emerging economies in Asia. Not surprisingly, growth in China has changed the distribution of economic activities across the world. Between 1980 and 2007, the share of Chinese GDP in the world economy increased from 1.7% to 5.9% (valued at market exchange rates; the share would be even higher if purchasing power adjusted prices were used). Now, China is one of the most important exporting and importing nations worldwide. India seems to be following the development path of China more recently (see Winter and Yusuf, 2007, and Ysuf et al., 2007), although India concentrates more on services than does manufacturing-oriented China. Moreover, in 2007 India's share of global output was only 2.2%. Furthermore, rapid trade growth in Asia has been supported by large investment flows (see Eichengreen and Tong, 2005, and Lane and Schmukler, 2007).

The new structure of the world economy has also important implications for business cycles around the world. The increasing weight of emerging countries, especially the trade shares of the largest emerging Asian countries (China and India), have led to faster global growth. Despite the globalization trend, business cycles in industrial countries and emerging Asian economies have so far remained largely independent of each other. This is referred to as decoupling of business cycles in the recent literature (see Kose et al., 2008, Akin and Kose, 2008, He et al., 2007). Nevertheless, recent developments since the onset of the global financial crisis in the second half of 2008 show that also these countries are not autonomous. IMF (2008) argues that the current slowdown of the world economy could have a significantly larger impact on Asian economies than earlier global downturns, because of more extensive trade and financial integration of Asian economies, especially with the USA. Furthermore, Hong et al. (2009) show in their historical analysis that earlier worldwide financial crises often had overwhelming impacts on the Asian economies.

Trade flows are generally seen as important determinants of business cycles. Frankel and Rose (1998) find a robust positive relationship between trade intensity and correlation of business cycles between OECD countries. There is already a rich literature on trade between South Asian countries and the developed countries (see Bussière et al., 2008), and some papers also look at the determinants of the business cycles in South East Asia. Among others, a special issue of the World Economy was devoted to this issue (see de Grauwe and Zhang, 2006). However, there are only a handful of papers dealing with the synchronization of business cycles in developed countries with those in emerging economies, and these (see Hughes Hallett and Richter, 2008, and Kose et al., 2008) often concentrate on description of stylized facts of business cycles in various regions. This paper extends the discussion by analyzing the determinants of business cycle convergence and divergence between OECD countries and the two largest emerging economies in Asia (often referred as the Asian giants).

The main results of our paper are as follows. First, we show that business cycles in China and India have been very different from those of OECD countries, which favors the decoupling hypothesis. Second, the current global financial crisis has had largely similar effects on industrial countries and on emerging Asian economies, which would speak against decoupling. Finally, we analyze the relationship between trade and the degree of business cycle synchronization of emerging Asian economies with the industrial countries. We show that more intensive trade ties between the large Asian emerging economies and the OECD countries do increase business cycle correlations between them.

The paper is structured as follows. The next section presents a literature survey on determinants of business cycle correlation with special focus on emerging economies. Section 3 describes the growth experience of Asian emerging economies as compared to the industrial countries, both before and during the present financial crisis. Section 4 continues with an analysis of moving correlations between the two regions. Section 5 introduces the concept of dynamic correlation and presents dynamic correlations between GDP growth rates in emerging Asia and OECD. We also study how the financial crisis influenced co-movements of output in Asian emerging economies and industrial countries for different frequencies. Section 6 analyses the determinants of dynamic correlation of business cycles in Asian emerging economies, and the last section concludes.

2 International transmission of business cycles

Economic development is determined both by domestic (e.g. aggregate demand shocks and budgetary policy) and international factors (external demand and international prices of traded goods). In open economies, the latter are playing an increasingly important role and often determine also domestic policies, which are aimed at insulating the economy from adverse external economic shocks. The Asian emerging economies with their strong export orientation could therefore be heavily exposed to foreign shocks (He et al., 2007).

In their seminal paper, Frankel and Rose (1998) show that trade, and more generally economic integration among countries, can result in increased synchronization of business cycles between individual countries, since trade links serve as a channel for transmission of shocks between countries. In line with these considerations, Kenen (2000), using a Keynesian model, shows that the correlation between two countries' output changes increases with the intensity of trade links. In turn, Kose and Yi (2006) analyze this issue in an international real business cycle model and conclude that, although the model suggests a positive relationship between trade and output, the effects are quantitatively small. However, the hypothesis of a positive relationship between trade and business cycles also has its opponents. For example, Krugman (1993) points out that as countries become more integrated, they can specialize to a greater extent. That is, the importance of asymmetric or sector-specific shocks increases with economic integration. This result may more cogently explain business cycles in emerging Asian economies (see Bátorová et al., 2008).

In the empirical literature, the role of trade links has been studied extensively in this context. Despite theoretical ambiguities, several authors have demonstrated that countries trading more intensively also exhibit a higher degree of output co-movement (see e.g. Frankel and Rose, 1998, and Baxter and Kouparitsas, 2005). However, it is not trade relations per se which may induce business cycle synchronization. Indeed, Frankel and Rose's hypothesis underlines that bilateral trade is mainly intra-industry trade, although this indicator does not directly enter their analysis. Basically, the idea is that specialization increases the exposure to sector-specific shocks, which are transmitted via intra-industry trade. This, to an extent, combines Krugman's insights with those of Frankel and Rose. Fontagné (1999) discusses the relation between intra-industry trade and the symmetry of shocks in a monetary union. Fidrmuc (2004) and Artis et al. (2008) show that intra-industry trade is a better indicator of business cycle asymmetries than simple trade intensities.

Foreign trade is not the only factor affecting the degree of business cycle correlation. In many theoretical models, a greater degree of financial integration leads to lower business cycle correlation. In a standard two-country model with perfect capital mobility, the country encountering a positive productivity shock also receives capital inflows from the other country, leading to less similar business cycles.[1] Moreover, more complete financial integration enables greater specialization, which leads to lower correlation of national business cycles, as in Krugman (1998). However, in many empirical studies the correlation between financial integration and similarity of business cycles has been positive. Nevertheless, Kalemli-Ozcan et al. (2009) find that in a sample of twenty high income countries negative correlation does obtain when one controls for country-pair-specific factors as well as the global trend to greater integration. Given China's relatively strict capital controls, it is not certain whether e.g. the increased flows of foreign direct investment would increase or decrease business cycle correlation. Since China and India seem to be specializing vertically in their foreign trade, this channel may be less important for their business cycles. Actually, the specialization forces discussed by Krugman (1993) can dominate, which can cause business-cycle divergence between the emerging Asian giants and their trading partners.

So far, the literature on business cycle correlation has concentrated mainly on developed economies. However, a number of studies have looked at business cycle correlation in Eastern Asia. For example, Sato and Zhang (2006) find common business cycles for the East Asian region. Moreover, Shin and Sohn (2006) find that trade integration (but much less financial integration) enhances the co-movement of output in East Asia.[2] Kumakura (2006) finds that increasing the share of electronic products in foreign trade increases business cycle correlation for the countries around the Pacific. Also Shin and Wang (2004), Rana (2006 and 2007), and He et al. (2007) find that trade is an important determinant of business cycle correlation for East Asian countries. Iwatsubo and Ogawa (2009) analyze the similarity of external adjustments between Asian economies.

So far, very few papers have looked at the correlation of business cycles in China and other emerging Asian economies versus those of the OECD countries. Hughes Hallett and Richter (2008) analyse the declining importance of the USA for Asia. Kose et al. (2008) find that there has been a convergence of business cycles within the OECD countries and within the emerging markets (including non-Asian countries) but a decoupling of business cycles between these two groups.

[1] An opposite view is presented e.g. by Imbs (2004).

[2] Kočenda and Hanousek (1998) document a high degree of convergence and integration of the Eastern Asian capital markets.

Table 1 Descriptive statistics of growth performance, 1990Q1-2008Q4

	Mean	Max	Min	St. deviation
Austria	0.006	0.022	-0.012	0.007
Belgium	0.005	0.064	-0.060	0.014
Denmark	0.004	0.028	-0.021	0.005
Germany	0.004	0.027	-0.021	0.008
Spain	0.007	0.039	-0.019	0.009
Finland	0.005	0.031	-0.034	0.013
France	0.004	0.021	-0.012	0.005
UK	0.006	0.014	-0.016	0.005
Italy	0.003	0.042	-0.019	0.008
Netherlands	0.006	0.021	-0.009	0.005
Portugal	0.004	0.043	-0.058	0.015
Sweden	0.009	0.034	-0.043	0.014
Switzerland	0.003	0.016	-0.009	0.005
Norway	0.009	0.052	-0.064	0.025
USA	0.006	0.018	-0.016	0.006
Canada	0.007	0.085	-0.015	0.011
Australia	0.008	0.026	-0.009	0.007
New Zealand	0.007	0.043	-0.032	0.011
Turkey	0.010	0.333	-0.220	0.058
Mexico	0.007	0.039	-0.062	0.015
Israel	0.010	0.065	-0.038	0.022
Japan	0.000	0.029	-0.010	0.006
Korea	0.012	0.038	-0.088	0.017
China [A]	0.023	0.077	-0.027	0.014
India [B]	0.016	0.036	-0.009	0.010

Note: All variables are defined as first differences of seasonally adjusted indices in natural logarithm. A – period 1992Q1-2008Q4. B – period 1993Q1-2008Q3.

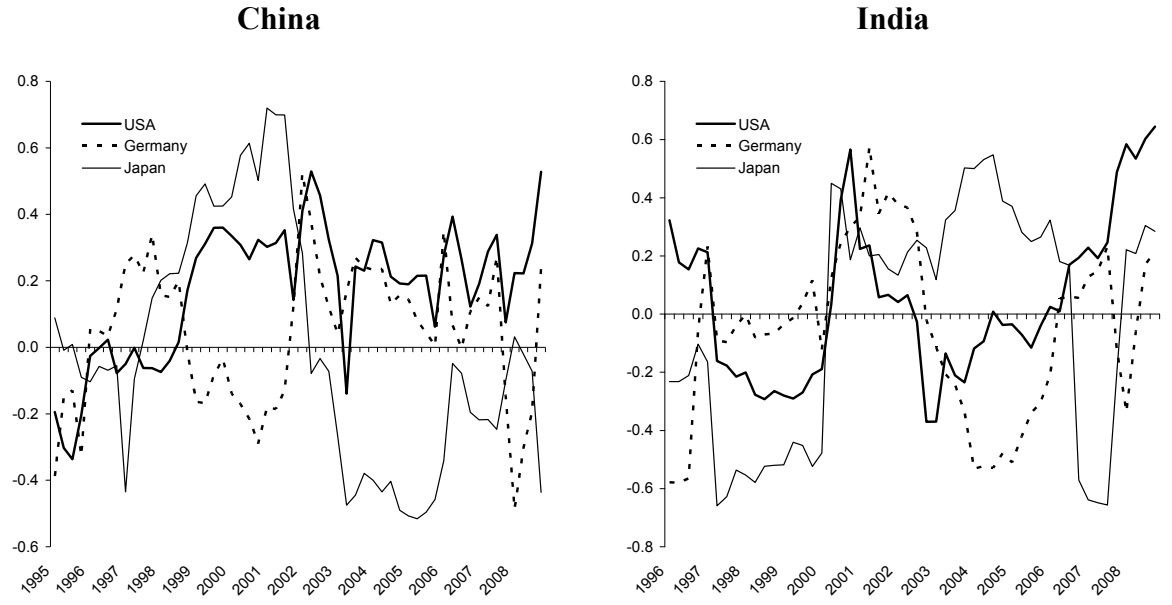
3 Data description

We use quarterly GDP data from the IMF's International Financial Statistics. For developed countries, the time series start in the 1970s or 1980s. For India, we use IMF data between 1993 and 2008. Where seasonal adjustment is required, we use the U.S. Census Bureau's X12 ARIMA procedure applied to the whole available period.

Because the Chinese statistical authorities do not publish a quarterly real GDP series, we used the GDP deflator (available for a part of the sample period) to obtain real GDP from the quarterly series of nominal GDP. For periods in which the GDP deflator is not available, we were able to use the implicit GDP deflator based on Chinese statistical authorities' reported year-on-year growth rates of real GDP.

It should be noted that average growth has been higher in India and especially in China than in the OECD countries (see Table 1), and volatility of growth rates is relatively high there, in light of the size of the economies. During this decade China has been among the world's fastest-growing economies, and India has lagged only slightly behind it. In recent years both growth of both economies has remained remarkably stable before accelerating in 2007. In 2008, the global financial and economic crisis led to a definite growth slowdown in both countries. While both China and India have used domestic policies to support growth, imploding exports have lead to a slowing of overall economic growth.

Figure 1 Moving correlations of selected countries, 1995-2008



Source: IMF, Own calculations.

4 Moving correlations of international business

Business cycles of emerging Asian economies are generally characterized by a low degree of business cycle correlation with developed countries (Kose et al, 2008). This result is at odds with the observations of Frankel and Rose (1998), as especially China has significant trade ties with major developed countries. Kose et al. (2008) show that there is some degree of business-cycle convergence within the groups of countries (emerging economies and industrial countries), whereas they cannot confirm convergence between the two groups. Bátorová et al. (2008) show that the low level of business cycle correlation is likely due to trade specialization of emerging economies in specific industries or production phases (especially intermediate products). In turn, trade among the developed economies consists mainly of intra-industry trade, which supports synchronization of the business cycles in the medium and long run. In a different vein, Pula and Peltonen (2009) show that trade statistics have been overestimating the level of integration, due to multiple counting of processed products. Their hypothesis is confirmed by their analysis of input-output tables for selected Asian economies. The high level of labor specialization means that the actual weight of trade links between the countries is significantly lower than suggested from raw trade data. Dean et al. (2008) arrive at a roughly similar conclusion.

Nevertheless, the global financial crisis in 2008 is likely to cause similar declines of aggregate output in all regions. Figure 1 shows the moving correlations of quarter-on-quarter GDP growth rates for a four-year moving window. For example, the correlation coefficient for 2008Q3 shows the correlations of business cycles in China/India with selected countries between 2005Q4 and 2008Q3. On average, business cycle correlations are zero for the whole sample, which confirms the decoupling phenomenon described in earlier papers. The results show also that the current financial crisis actually caused some increase of business cycle correlation between the large emerging economies in Asia and the USA. The slowing of growth in China, India and the USA began already in early 2008. However, the correlation with Germany remained relatively low also in 2008, while the similarities of business cycles with Japan have been even reduced.

The pattern of international business cycles is much more volatile if we look at the co-movements of all developed countries versus China/India. The effects of structural changes can be found via analyses of correlations within moving windows (see e.g. Rana, 2006). To describe the properties of international business cycles, we estimate the following panel regressions:

$$\frac{1}{2}\log\frac{1+\rho_{i,t}}{1-\rho_{i,t}} = \alpha_i + \beta_i Trend_t + \beta\, D97_t + \sum_{q=1}^{4}\gamma_q D_q + \varepsilon_{i,t} \qquad (1)$$

where ρ is the moving correlation coefficient of detrended output in selected countries versus China/India. We note that the correlation coefficient is bounded between -1 and 1 and use the Fisher transformation to transpose its values to an unbounded variable. The explanatory variables include trend, which shows whether there is some convergence of international business cycles, and dummy variables, D_q, for the individual quarters of 2008, which show the impact of the global financial crisis on China and India. We also include a dummy variable for the Asian crisis between 1997Q1 and 1998Q4, $D97$. The effects of the Asian crisis in 1997 and 1998 also provide an interesting benchmark for discussion of the current financial crisis (Hong et al., 2009).

Table 2 Business cycles convergence and financial crisis, 1995 to 2008

	China				India			
	All Countries		Core OECD		All Countries		Core OECD	
Trend	0.003	***	0.003	***	0.000		-0.001	
	(4.584)		(3.683)		(0.182)		(-1.611)	
Asian crisis (1997-1998)	0.063	**	0.072	**	-0.154	***	-0.203	***
	(2.093)		(2.131)		(-5.074)		(-6.108)	
Dummy for 2008Q1	0.055		0.063		0.387	***	0.430	***
	(0.804)		(0.816)		(5.853)		(5.934)	
Dummy for 2008Q2	0.120	*	0.118		0.462	***	0.499	***
	(1.744)		(1.529)		(6.960)		(6.878)	
Dummy for 2008Q3	0.183	***	0.171	**	0.595	***	0.646	***
	(2.661)		(2.215)		(8.951)		(8.869)	
Dummy for 2008Q4	0.258	***	0.323	***				
	(3.741)		(4.173)					
Constant	-0.040		-0.034		-0.080	**	-0.038	
	(-1.273)		(-0.965)		(-2.154)		(-0.929)	
No. of countries	24		19		24		19	
No. of quarters	56		56		51		51	
No. of observations	1344		1064		1224		969	

Note: The dependent variable is the moving correlation of detrended GDP in selected countries. Core OECD: Austria, Belgium, Denmark, France, UK, Finland, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, USA, Australia, Canada, Japan, Portugal, Spain, and New Zealand. Emerging economies: Mexico, Israel, Korea, Turkey, China, and India. The dummy for Asian crisis in 1997-1998 equals one from third quarter of 1997 to fourth quarter of 1998, and zero otherwise. *t*-statistics are reported in parentheses. *, **, *** denote significance at 10, 5 and 1 per cent level, respectively.

The results of this simple regression are given in Table 2. With respect to the discussion of decoupling, they confirm a weak positive trend of business cycle synchronization for both India and China. However, correlation of Chinese business cycles with other countries increases by just 0.01 per year on average. In India, the trend is statistically insignificant. The Asian crisis between the third quarter of 1997 and fourth quarter of 1998 had different effects on China and India: the 1997 crisis modestly increased the degree of business-cycle correlation for China, while it significantly decreased the similarity of Indian business cycles with those of other countries.

Finally, we can see that the financial crisis had the same impact on Asian emerging economies as on the industrial countries. In China, the effect is significant already in the second half of 2008, and it is especially strong in the last quarter of 2008, despite fiscal expansion in China. The same pattern of development can be seen for India. The impact was significant already in the first half of 2008. Similarly to China, the third quarter showed greater similarity with business cycles in other countries. The differences between regional groups are modest. Unfortunately, the last quarter was not yet available for India.

5 Dynamic correlation analysis of business cycles in emerging Asia

Correlation analysis is the most common approach for describing output synchronization between countries. Classical correlation is a standard measure of co-movement between time series. Unfortunately the classical correlation has two main drawbacks: first, it does not allow separation of idiosyncratic components and common co-movements. Second, it is basically a static analysis that fails to capture any dynamics in the co-movement. An alternative measure of synchronization in the case of business cycles is dynamic correlation, as was proposed by Croux et al. (2001).

Consider two stochastic process, x and y, with defined spectral density functions, $S_x(\lambda)$ and $S_y(\lambda)$, and a co-spectrum $C_{xy}(\lambda)$, which are defined for all frequencies $-\pi \leq \lambda \leq \pi$. Then, the dynamic correlation according to Croux et al. (2001), $\rho(\lambda)$, is defined as

$$\rho_{xy}(\lambda) = \frac{C_{xy}(\lambda)}{\sqrt{S_x(\lambda) S_y(\lambda)}}. \qquad (2)$$

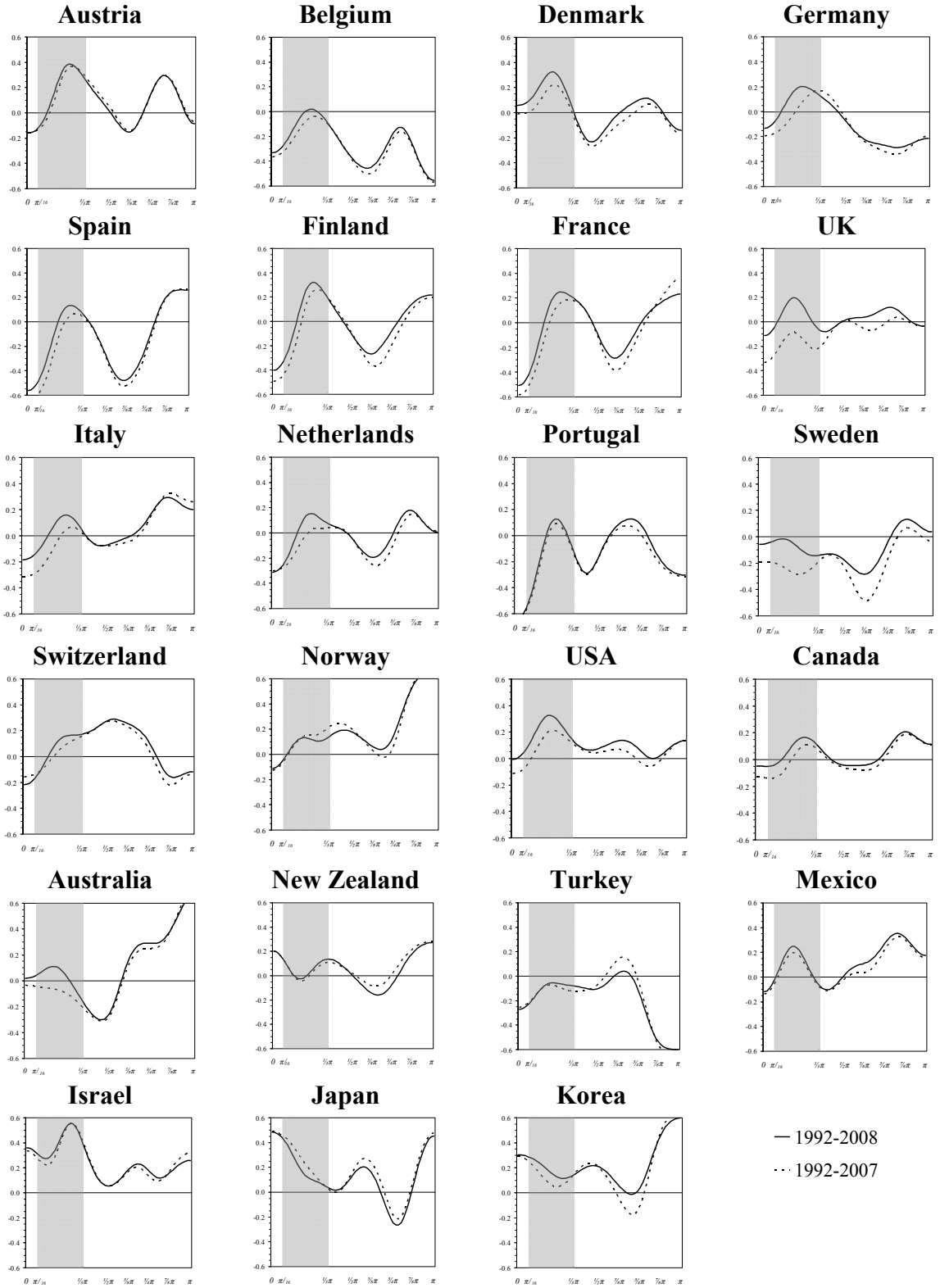
The dynamic correlation coefficient is defined to be between -1 and 1, as is the standard correlation coefficient. Moreover, the average value of dynamic correlation over all frequencies is approximately, although not exactly, equal to the static correlation. Therefore, we can interpret dynamic correlations as a decomposition of the aggregate correlation into co-movements at particular frequencies. Dynamic correlations show whether the global financial crisis influenced mainly short-term co-movements or also business cycle frequencies.

Figures 2 and 3 present dynamic correlations of business cycles in both Asian emerging economies and in selected industrial countries. We present two different periods in both figures. The full line shows dynamic correlations for the whole available period. The dotted lines show the level of synchronization of co-movements at various frequencies before the outbreak of the financial crisis. The differences between both indicators show the impact of the global financial shock of 2008 on output co-movements by frequencies.

As usual in the literature, we look at three components of the aggregate correlation. First, the long-run movements (over 8 years) correspond to the low frequency band below $\pi/16$. Second, the traditional business cycles (lasting between 1.5 and 8 years) belong to the medium part of the figure (marked as a shadow area) between $\pi/16$ and $\pi/3$. Finally, the short-run movements are defined by frequencies over $\pi/3$. Although it is common in the literature to neglect these developments, we will examine them here because the short-run dependences of economic development may be more important for China and India. It might also be expected that short-term shocks impact especially the co-movements in this range, while permanent shocks should influence the business cycle frequencies.

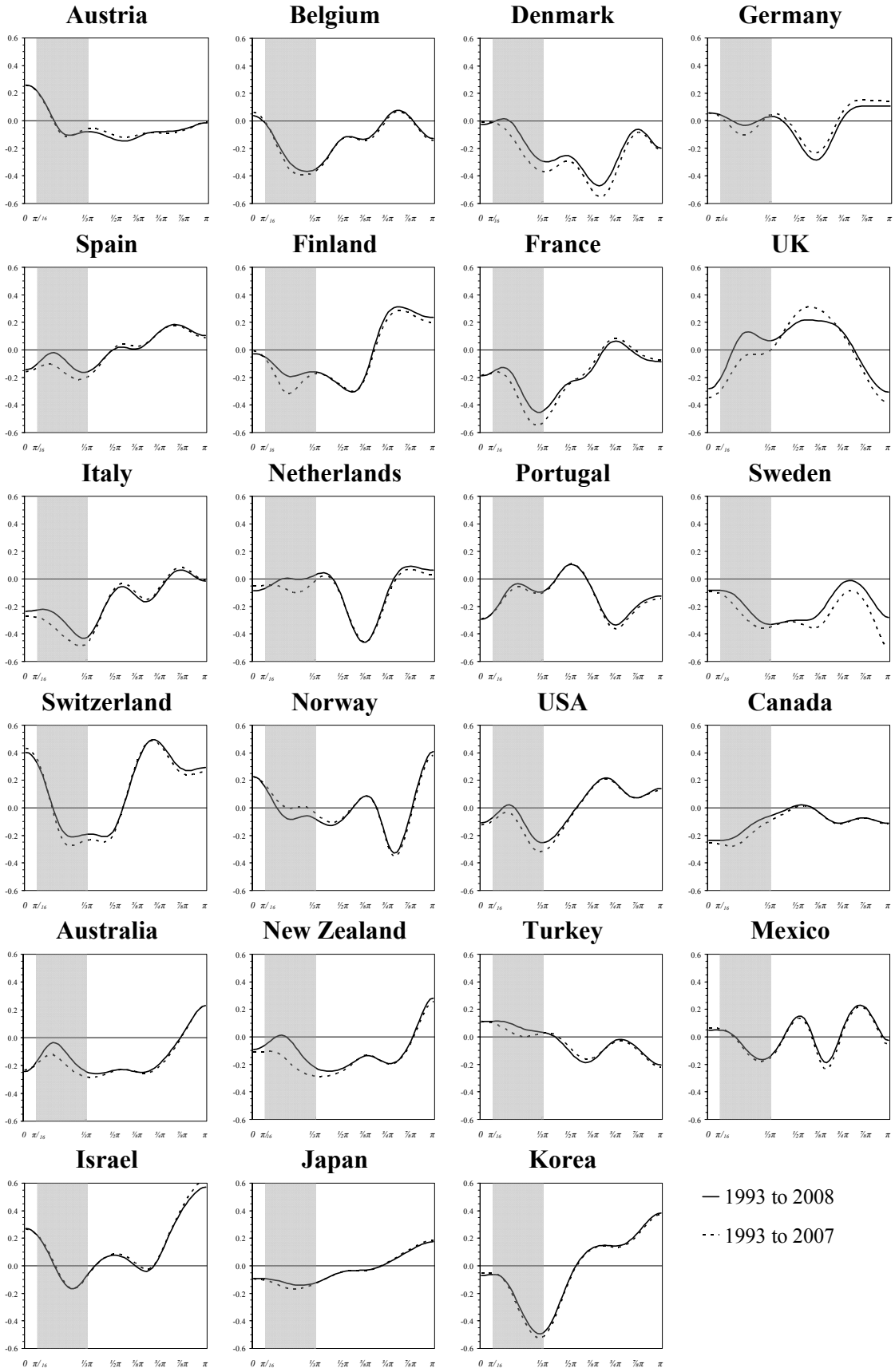
We can see that business cycles in the large Asian emerging economies and selected developed economies vary significantly over the frequencies. The pattern is remarkably similar for China and India, in contrast to the pattern of dynamic correlations between developed economies. Both countries also show greater similarities with other emerging economies (e.g. Israel, Korea, Mexico, and Turkey).

Figure 2 Dynamic correlations of China with selected countries



Note: The *x*-axis shows frequencies defined on the interval $0 \leq \lambda \leq \pi$. Business cycle frequencies are marked by shaded areas. The *y*-axis shows the dynamic correlations for individual frequencies.

Figure 3 Dynamic correlations of India with selected countries



Note: The *x*-axis shows frequencies defined on the interval $0 \leq \lambda \leq \pi$. Business cycle frequencies are marked by shaded areas. The *y*-axis shows the dynamic correlations for individual frequencies.

In particular, the OECD countries usually show high dynamic correlations for business cycle frequencies and long-term co-movements (see Croux et al, 2001). By contrast, China and India display quite low levels of dynamic correlations, especially for the business cycle frequencies (between $\pi/16 \approx 0.2$ and $\pi/3 \approx 1$). This confirms the decoupling hypothesis for both countries. Only a few countries show positive dynamic correlations at the business cycle frequencies. These include especially the non-European OECD countries (USA, Korea, Israel, and Japan). To a lesser degree, we can see also small positive correlations of long-run developments in Austria, Denmark, Finland, and perhaps the UK. In general, the non-European OECD countries trade more intensively with China than with the other countries in our sample, which may explain some of the business cycle correlation. For India no clear pattern of trade could be discerned. Our results are also similar to the earlier findings by Shin and Sohn (2006) and Sato and Zhang (2006). As before, the non-European OECD countries also show a positive correlation at the lower range of the interval (close to eight years).

We also find wide differences between the various short-run frequencies. In general, the dynamic correlations tend to increase at the right end of the spectrum. This would correspond to strong business linkages between suppliers from Asia and final producers in the developed countries. For China, the short-run correlations are high, especially for the USA, Korea, Japan, and Israel. All these countries can be characterized as having very close relationships with China over a longer period. Short-run correlation with the Indian business cycle is positive for Finland, Norway and Switzerland, even though their trade with India is quite modest. Only a few countries show comparably high positive correlation of long-run cycles with China and India. The dynamic correlations are usually slightly lower for India than for China, over the whole range of frequencies.

Finally, the comparison of dynamic correlations with and without data for 2008 shows that especially dynamic correlations at business cycle frequencies have increased since the start of the global financial crisis. This pattern is stronger for China than for India. For both countries, the changed pattern can be seen especially in relation to the USA, UK, and Australia. By contrast, some small European economies (e.g. Austria), but also Korea and Mexico (for India, see Figure 3), show remarkable stability of business cycles as compared to China and India. This can be caused by important country-specific shocks before 2007 in these countries. As adding only a few observations does not alter the sample significantly, it is noteworthy that in almost all cases the solid line is above the dotted line, if any difference can be discerned.

The impact of the global financial shock especially on the business cycle frequencies contradicts the decoupling hypothesis. The current development would imply that the low degree of business cycle synchronization may correspond to the large size (especially when we take population and GDP in purchasing power parity into consideration) of the emerging economies in Asia. The links between these economies and the industrial countries may also be weaker than suggested by the aggregate trade statistics (see Pula and Peltonen, 2009). Finally, the importance of idiosyncratic domestic shocks is likely to play an important role also in the low levels of business cycle correlation with the industrial countries.

6 Factors explaining the pattern of dynamic correlations

In addition to the stylized facts of the previous section, we briefly assess trade intensity as a potential determinant of business cycle synchronization between the Asian emerging economies and the OECD countries. In particular, we test whether the extent of foreign trade between a country and the emerging Asian giants influences dynamic correlations at the individual frequencies. The more intensive a country's trade links with the emerging Asian countries, the stronger should be the synchronization of co-movements in economic activity with the region. Furthermore, the degree of synchronization may be different for different frequencies, because e.g. different economic policies may cause divergence between business cycles. We use foreign trade data from the IMF's Direction of Trade statistics to calculate the average shares of China and India in exports and imports of the OECD countries between 1995 and 2006. We use the ratio of this average to GDP in our empirical analysis. The period under review captures the rapid growth of China's foreign trade. It shows the degree of trade links before the onset of financial crisis in 2008.

In the previous section we calculated the dynamic correlation between Chinese and Indian GDP growth and growth in 23 OECD countries. As we saw earlier, correlations differ greatly across the OECD countries. Although it is difficult to see any clear pattern of dynamic correlations, our previous results showed that dynamic correlations tend to be higher for countries with intensive trade links with China and India. Moreover, comparison of dynamic correlations in 2008 and 2007 showed that especially the business cycles of China and India have become more similar to the business cycles of its main trading partners. This section tests this hypothesis. In particular, we estimate the following for the standard correlation and the dynamic correlation at all frequencies λ,

$$\rho_j(\lambda) = \beta_1(\lambda) + \beta_2(\lambda)\log(x_j) + \varepsilon_j(\lambda) \tag{3}$$

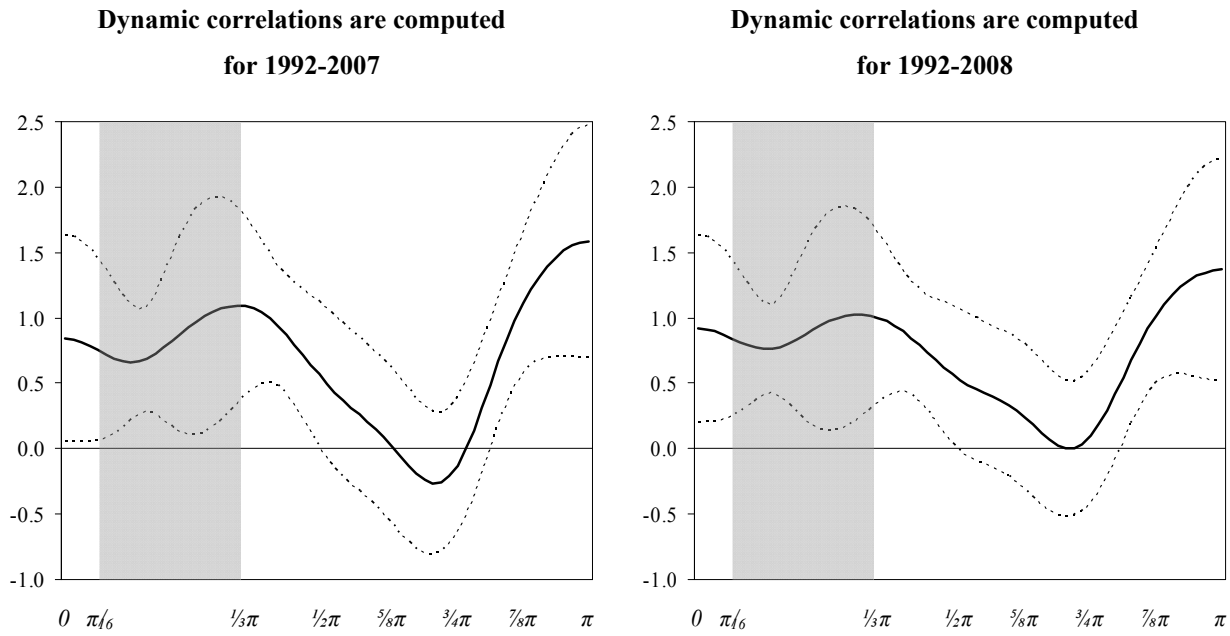
Trade intensity before the financial crisis, denoted by x, is defined as the ratio of bilateral trade (average of exports and imports between 1995 and 2006) between OECD country j and China or India to GDP of the particular OECD country. This indicator shows the importance of both Asian countries to the OECD countries. We have 23 observations for each country paired with China and India, i.e. 46 observations for each frequency. Table 3 presents the regression results for the static correlation and selected intervals of dynamic correlations, which were computed for the period 1990 to either 2007 or 2008. Moreover, we present the parameter β2 for the individual frequencies in Figure 4.

Table 3 Determinants of business cycles convergence

	Static correlation		**Business cycle frequencies**		**Long-run frequences**		**Short-run frequences**	
	1992-2007	1992-2008	1992-2007	1992-2008	1992-2007	1992-2008	1992-2007	1992-2008
β_1	-0.090 ***	-0.064 ***	-0.125 ***	-0.066 **	-0.151 ***	-0.126 ***	-0.060 **	-0.046 *
	(-3.927)	(-3.057)	(-4.409)	(-2.526)	(-3.087)	(-2.820)	(-2.308)	(-1.904)
β_2	0.719 ***	0.722 ***	0.859 ***	0.892 ***	0.821	0.899 *	0.586 **	0.622 **
	(2.835)	(3.130)	(2.737)	(3.062)	(1.518)	(1.808)	(2.041)	(2.298)
N	46	46	46	46	46	46	46	46
$\overline{R}^2$	0.135	0.164	0.126	0.157	0.028	0.048	0.066	0.087

Note: *t*-statistics are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 per cent level, respectively.

Figure 4 Regression results for trade intensity by requencies



Note: The *x*-axis shows frequencies defined on the interval $0 \leq \lambda \leq \pi$. The *y*-axis shows the value of parameters estimated in (3) for individually frequencies. Confidence bands are constructed as 1.96 standard errors. Business cycle frequencies are marked by shaded areas.

We do not include variables on financial integration to (1), although this was usually done for OECD countries (Imbs, 2004, Baxter and Kouparitsas, 2005, Artis et al, 2008). However, these studies also show that the effects are often similar, because trade integration goes usually hand in hand with financial integration. Bátorová et al. (2008) show that OECD countries' foreign direct investment (FDI) into China correlates with their trade to and from China, for example. According to China's State Administration of Foreign Exchange (SAFE, 2009) inward FDI stock accounted for almost 60% of China's international liabilities at the end of 2007. As China maintains capital account restrictions for many transactions, this is not surprising. Portfolio liabilities were only 11% of the total.

Although the results have to be viewed with some caution, they largely confirm the stylized facts of the previous section. In both analyzed years, trade intensity between the OECD countries and the Asian giants has a significant effect on the change in dynamic correlation of GDP at the business cycle frequencies. In turn, trade intensity has a milder effect on the dynamic correlation of GDP movements at the short-run frequencies (see Figure 4), and it becomes insignificant at the right-hand side of the spectrum. The results confirm the positive relationship found usually for the OECD countries in the earlier literature following the initial contribution by Frankel and Rose (1998).

The global financial crisis starting in 2008 has probably increased the closeness of the link between business cycles and trade in emerging economies, as all coefficients estimated for the period 1992-2008 are higher than those for 1992-2007. Moreover, the share of explained variance in Chinese and Indian co-movements with OECD countries increased after the financial crisis, although it remained relatively low. The most obvious explanation for the increased correlation of business cycles in the run-up and during the crisis is of course the collapse of foreign trade, which has affected both India and especially China. The financial crisis itself has had less of an impact for these countries, as their financial markets and banks are less integrated with the global financial system.

7 Conclusions

Globalization has been one of the major events in the world economy in the last two decades. China and India played only a marginal role in the world economy before the 1990s. Whereas China was a predominantly agrarian economy before 1980, it is now to a large extent a modern industrial economy with booming urban regions. More recently, India has joined this pattern of economic development. We show that during the past two decades the business cycles in the large emerging Asian economies and in the developed economies have been quite different. Many transnational companies use emerging markets as a part of their production chains and this is especially true for the Asian economies. Despite this, most developed countries show low or even negative dynamic correlations with China and India for the traditional business cycles (cycles with periods between 1.5 and 8 years), which is generally referred to as decoupling of business cycles. However, the co-movements of business cycles have generally increased as a result of the global financial crisis. This contradicts the decoupling hypothesis discussed in the earlier literature, or at least represents a temporary setback in the possible trend towards lower correlation of GDP growth rates across major economies of the world. Our results indicate that the low level of business cycle synchronization between the Asian emerging economies and industrial countries is a result of idiosyncratic shocks in the former economies, which are still significantly poorer than OECD countries.

It seems that countries with tighter economic ties with China and India also have higher dynamic correlation with these economies. This is especially true for long-term developments. However, trade integration now plays a diminished role for the convergence of business cycles than

that documented for business cycles between the OECD countries. In sum, our first results confirm a special position of the emerging Asian giants in the business cycles of the world economy. Despite the increased trade links between the countries, both China and India behave quite differently from the rest of the world economy. This may be related to the shift of production from the OECD countries to the emerging Asian economies.

Nevertheless, it should be noted that the recent economic crisis seems to have brought the Chinese and Indian business cycles closer to the OECD cycles. This may be because of the large common shocks e.g. to the global financial sector and the resulting implosion in investment demand in practically all countries of the world. However, our dynamic correlation analysis does not provide evidence as to possible directions of causalities. Instead of earlier dependence of emerging economies on developed countries (especially the US economy), the global economy may be moving to a situation characterized by increasing interdependencies between developed and emerging economies.

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